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Gage Jay Howard.  
The immature stages of the coccinellidae.



THE IMMATURE STAGES OF THE COCCINELLIDAE

BY

JAY HOWARD GAGE

A. B. University of Illinois, 1916

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THESIS

Submitted in Partial Fulfillment of the Requirements for the

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OF THE

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY  
SUPERVISION BY J. Howard Gage

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THE DEGREE OF Master of Science

Alex. W. MacGillivray

In Charge of Thesis

Stephen A. Forbes

Head of Department

Recommendation concurred in\*

Committee

on

Final Examination\*

\*Required for doctor's degree but not for master's



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## INTRODUCTION.

The adults of this family are known as lady-bugs or lady-birds to most persons. Their distinctive characteristics are the apparently three-segmented tarsi and the broad hatchet-shaped distal segment of the maxillary palpi. Other characteristics that might be mentioned are the eleven-segmented antennae in which the distal segments are commonly modified to form a more or less distinct club-shaped enlargement and which are usually inserted near the mesal margins of the compound eyes. The mouth is generally directed ventrad and the head is more or less retracted into the small transverse prothorax. The front coxae are transverse, and the coxal cavities except in *Coccidula* are closed behind. The elytra are convex, and the abdomen consists of five to seven exposed ventral segments.

LeBaron has said, in speaking of this family, that, "The Coccinellidae occupy a remarkably anomalous and isolated position. Whilst having the rounded form of the plant beetles, the clavate antennae of the scavengers, and the dilated palpi of the fungus beetles, they agree in food and habits with none of these, but resemble in their predaceous habits the ground beetles and the soft winged carnivora, all of which have their bodies more or less elongated, their tarsi five-jointed, their antennae filiform, and their palpi slender or moderately dilated."

The larvae of the Coccinellidae, on the other hand, though they may be known to many people as "niggers" or "alligators", are not as a rule associated with the adult coccinellids or lady-bugs. The most distinctive characteristics of these larvae





are their porcupine-like appearance, elongated body usually striped or mottled with red, black, white or yellow; small three-segmented antennae; powerful mandibles; and the habit of being continually on the move. From the systematists' point of view these larvae do not show any unusual characteristics such as LeBaron has noted for the adults, for they resemble in most respects the distinctly predaceous types of coleopterous larvae. This is true even of the Epilachninae which are phytophagous.

With the exception of the Epilachninae, the Coccinellidae are all more or less predaceous in their adult stages, and almost entirely so in their larval stages. Both larvae and adults are of great economic importance to the agriculturist, because their animal food is usually made up of plant-lice, coccids, mites, and to some extent chinch-bugs. In spite of the fact that the larvae of these beetles are of great economic importance, they have thus far received but little attention from systematic entomologists. Larvae found in the field have been reared and the adults identified, but the investigation has been dropped at this point. Such a process of identification is a waste of time and needless to say is very inconvenient.

The purpose of this investigation is to study the morphology of coccinellid larvae and to arrange tables for the identification and classification of a few of the more common species. The extent of this work has been limited to those genera and species, that have in the main been found<sup>in</sup> or reported from Illinois. Specimens were collected and bred during the autumn of 1918, and others were obtained from the collections of Dr. A.D. MacGillivray, the University of Illinois, the Illinois State Laboratory of



Natural History, and a specimen of *Brachyacantha ursina* from Cornell University.

The investigation of the immature stages of insects has been to a great extent neglected by entomologists until about the beginning of the twentieth century. There has been some previous work done, however, upon the immature stages of the members of this family. The works of L. Ganglbauer '99, Dimmock '06, Palmer '14, and Böving '17 are valuable to one pursuing a study of the immature stages of these beetles.

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## MORPHOLOGY.

This general discussion of the general comparative morphology of coccinellid larvae is based for the most part upon a study of *Chilocorus bivulnerus*. This species represents the most generalized condition of the carnivorous coccinellids that I have studied. A more generalized condition is found, however, in the subfamily Epilachninae, which are for the most part entirely phytophagous.

### 1 HEAD.

The heads of coccinellid larvae are symmetrical <sup>and</sup> the general outline is circular or nearly so, except in the genus *Microweisea* in which it is oval or oblong. In *Chilocorus* and *Epilachna*, the mouth is directed ventrad; while in all of the genera of the Coccinellini<sup>and</sup>, Hyperaspini, and <sup>in</sup> *Microweisea* it is directed caudo-ventrad. The greatest departure from the generalized condition is found in *Scymnus*. In this genus the mouth is directed cephalad. For the sake of convenience the head will be considered under two divisions; first, the fixed parts; second, the movable parts.

#### Fixed Parts of the Head.

The fixed parts of the head consist of an external and an internal skeleton. The external skeleton is composed of the fused front and postclypeus, preclypeus, vertex, labrum, and gula. The boundaries of these sclerites are marked by distinct furrows or sutures. The internal skeleton is made up of the floor-like tentorium which in the Coccinellidae consists of three parts.



### External Skeleton.

Epicranial Suture.- In the head capsule of *C. bivulnerus* the epicranial suture (Fig. 6, es) is present on the meson and extends from the occipital foramen (Fig. 17, of) to a point on the cephalic aspect about one-third the distance from the occipital foramen to a line drawn through the antennal fossae (Fig. 6, af). This part of the epicranial suture is the epicranial stem (Fig. 6, es). The epicranial stem bifurcates at its ventral end and the two epicranial arms (Fig. 6, ea) extend latero-ventrad a short distance, make a broad curve and extend ventro-mesad on each side to a point where they become much thickened. Each thickening is a pretentorina (Fig. 6, pt) and marks the point of invagination of the pretentorium. The epicranial arms curve broadly laterad and ventrad from each pretentorina to a point dorso-mesad of an antennal fossa where they become obsolete. The three sclerites included within or ventrad of the fork of the epicranial stem are the fused front and postclypeus (Fig. 6, fc), and the labrum (Fig. 6, l). There is an indistinct furrow which marks the position of the clypeal suture (Fig. 6, cs) on each lateral margin of the head. There is a distinct precoila (Fig. 6, pcl) in which a preartia (Fig. 6, ps) articulates located on each side of the postclypeus (Fig. 6, poc) meso-ventrad of the antennal fossa at the point of origin of the clypeal suture. The vertex occupies all of the dorsal and lateral parts of the head capsule not included within the fork of the epicranial suture (Fig. 6, v). There are six ocelli (Fig. 6, oc) two groups of three. Each group is situated on the lateral margin of the vertex dorsad and laterad of the lateral end of an epicranial arm. The antennal





fossae are located ventrad of the ocelli on the dorso-lateral margin of the vertex. The large somewhat oval opening in the caudal aspect of the head is the occipital foramen (Fig. 18, of).

A primitive type of epicranial suture is found in the adults of *Periplaneta* and the larvae of *Corydalus*. The condition of the epicranial suture in *C. bivulnerus* is very similar to that of these primitive forms, except that the epicranial stem is not so long in proportion to the length of the epicranial arms, and that a portion of each arm is wanting near the antennal fossae. This suture in *Epilachna* (Fig. 4, es) very closely resembles that of *C. bivulnerus*, but the epicranial stem is much longer and extends almost one-half the distance from the occipital foramen to a line drawn through the antennal fossae. In *Megilla* (Fig. 7, es), it is present, but very short, not extending more than one-fifth the distance from the occipital foramen to a line drawn through the antennal fossae; while in *Adalia*, *Anatis*, *Hippodamia*, *Coccinella*, and *Microwisea* the epicranial stem is not present and the epicranial arms diverge immediately from the occipital foramen. In the adult larval stage of *Hyperaspis*, the epicranial suture is wanting, but is present in the first instar. The epicranial stem is absent in the second instar, but the epicranial arms are present; while in the later larval instars the entire epicranial suture is wanting. The adult larvae of *Scymnus* (Fig. 14) also lack an epicranial suture; no observations were made on the conditions present in very young larvae.

The epicranial arms are present in most coccinellid larvae, but are absent in the adult larvae of *Scymnus* and *Hyperaspis*. In *C. bivulnerus*, the epicranial arms extend ventro-laterad from



their point of origin to a point dorso-mesad of the antennal fossae. In *Epilachna*, the epicranial arms extend ventrad of the antennal fossae, but do not extend as far laterad. In *Chilocorus* and *Epilachna*, the epicranial arms are not widely divergent, but in all of the genera of the *Coccinellini* they diverge widely and become obsolete slightly ventrad of the antennal fossae. In the first larval instar of *Hyperaspis*, they diverge immediately upon the dorso-cephalic aspect of the head, the epicranial stem being very short, and they extend laterad almost parallel with the caudal margin of the head, make an abrupt turn and extend laterad and ventrad to their point of obsolescence. In *Microwisea* (Fig. <sup>13</sup>73), the epicranial arms diverge gradually latero-ventrad and become obsolete dorsad of the antennal fossae. Due to the extreme length of the head in this genus, these arms are very long. In *Scymnus*, the epicranial arms are entirely wanting.

Front.- The two proximal unpaired sclerites between the arms of the epicranial suture in *Corydalis* are the fused front and postclypeus. These areas are separated from each other in the more generalized forms by the fronto-clypeal suture, however in the specialized forms they may become completely fused. In such cases the fronto-clypeal suture is absent but portions of it may be indicated by a furrow on each lateral portion of the head. These portions extend mesad from near the precoila. In *C. bivulnerus* and all coccinellid larvae the front and postclypeus (Fig. 6,fc) are completely fused, and the fronto-clypeal suture is wanting. The clypeal suture ( Fig. 6,cs) is indicated by an indistinct furrow extending mesad from the precoila ( Figs. 5,6, pcl). The area ventrad of this furrow is the preclypeus





(Fig. 6,pc) and the area dorsad of it is the fused front and postclypeus ( Fig. 6, fc). In *Epilachna* ( Fig. 4 ) the front and postclypeus are entirely separated from the preclypeus by the complete clypeal suture; while in all of the other genera of the family that were studied the condition of the clypeal suture is approximately that found in *Chilocorous*.

**Labrum.-** The labrum of *C.bivulnerus* is the distinct, slightly chitinized, shield-like sclerite attached to the ventral margin of the preclypeus ( Fig. 6,1) . The ventral margin of the labrum may be slightly emarginated and usually bears four or six medium sized setae. In general the structure of the labrum in all of the coccinellids studied very closely approximates the conditions found in the labrum of *C. bivulnerus*. Its general shape, however, varies in the different genera of the family. In the genus *Epilachna*, the labrum varies most widely from the *Chilocorous* type. In this genus, it is broadly transverse, and widely but shallowly emarginated on the ventral margin.

**Vertex.-** The vertex of *C. bivulnerus* ( Fig. 6,v) consists of the paired continuous areas on the cephalic and dorsal aspect of the head. In *Chilocorous*, *Epilachna*, and *Megilla*, the epicranial stem is present and marks the line of separation of the two halves of the vertex; in *Hippodamia*, *Coccinella*, *Anatis*, *Adalia*, and *Micro-weisea*, the epicranial arms alone are present and the two halves of the vertex do not meet on the meson, but a portion of the front extends between them to the occipital foramen. In *Hyperaspis* and *Scymnus*, the epicranial suture is absent and the front, postclypeus, and vertex are fused. The vertex is continuous on its lateral and



caudo-lateral margins with the genae ( Fig. 5,ge ), the region of the vertex ventrad and mesad of the ocelli and the antennal fossae. The size, shape, and extent of the vertex is dependent upon the location and extent of the epicranial suture.

**Ocelli.** In the head of *Corydalis* caudad of the antennae, there is a distinct ocularium which bears five or six ocelli. This indicates the position of the developing compound eyes. In *C. bivulnerus*, the ocelli ( Figs. 5,6, oc) are arranged three on each lateral aspect of the head dorsad of the antennal fossae. They are usually arranged in the form of a triangle. These ocelli are undoubtedly the homologues of the ocelli of *Corydalis* and represent the developing compound eye of the adult. The arrangement, number, and position of the ocelli is fairly constant in all of the genera of the family. There is only one exception worthy of note, the ocularium of *Scymnus* is darkened and slightly chitinized. Two of the ocelli are equal in size while the third is almost twice as large as either of the others.

**Gula.-** In generalized insects, the gula is present as a distinct chitinized sclerite extending cephalad from the occipital foramen to the articulation of the maxillae and submentum. It is bounded on its lateral margins by the postgenae. In all of the larvae of the *Coccinellidae*, the gula (Fig. 17, g) is present as a more or less membranous, rectangular, glabrous area caudad and dorsad of the submentum.

#### Internal Skeleton.

The internal skeleton of the head of insects is formed by invaginations. It serves undoubtedly to make the head more rigid,





support the soft and delicate parts, and as a place for the attachment of muscles.

**Tentorium.-** The entire internal skeleton of the head is known as the tentorium (Fig. 47). It consists of two or three pairs of arms that have been invaginated from the external skeleton. In the more primitive forms there may be only two pairs. In all of the larvae of the Coccinellidae, there are three distinct pairs of arms.

**Pretentoria.-** The pretentoria, also known as the anterior arms of the tentorium ( Fig. 47 prt), are invaginated on the dorsal aspect of the head near the point where the epicranial arms turn abruptly laterad.

**Supratentoria.-** The supratentoria, sometimes called the dorsal arms of the tentorium ( Fig. 47, sup), are invaginated mesad of the antennal fossae and are well developed in the Coccinellidae.

**Metatentoria.-** The metatentoria, or the posterior arms of the tentorium ( Fig. 47, met), are invaginated on the ventral aspect of the head near the articulation of the maxilla.

**Corpotentorium.-** In many insects, the occipital foramen is divided into two parts by a distinct bridge. This bridge is the corpotentorium. In coccinellid larvae, the corpotentorium is not united to form a complete bridge, however, the mesal boundaries of the two lobes which represent the corpotentorium ( Fig.47,cp) approximate each other very closely on the ventral aspect of the head, and are located much nearer the mouth than the occipital foramen. The metatentoria extend dorsad from their point of invagination along the gular sutures toward the occipital foramen



and form important landmarks for the identification of the gula. When they reach the occipital foramen, they diverge laterad and form a ring around the entire opening.

**Laminitentorium.**- The small bridge-like structure about one-half way between the lobes of the corpotentorium and the occipital foramen is the laminitentorium ( Fig. 47,lt). It is formed by the fusion of the ends of the pretentoria, supratentoria, and metentoria.

**Pretentorina.**- The small pit on the ectal surface of the dorso-cephalic aspect of the head where each pretentoria is invaginated is the pretentorina.(Fig. 4, pt).

**Supratentorina.**- The point on the ectal surface of the head marking the invagination of the supratentoria is the supratentorina (Fig. 6,supt). It is not present as a pit in coccinellid larvae.

**Metatentorina.**- The metatentorina is the point of invagination of the metatentoria on the caudo-ventral aspect of the head (Fig. 18, mett). This point is also not indicated by a pit or thickening.

### Movable Parts.

The form, structure, and arrangement of the movable parts of the head of coccinellid larvae are readily homologized with the movable parts of the heads of generalized insects, such as *Periplaneta* or the larvae of *Corydalis* or *Carabidae*. The movable parts consist of the antennae, mandibles, maxillae, and labium.

**Antennae.**- The antennae of *C. bivulnerus* (Fig. 36) are about as long as wide, slightly conical and composed of three





segments. The scape (Fig. 36, sc) is cylindrical, wider than long, slightly chitinized, and with a few fine setae. The scape is attached to the heavily chitinized antennaria which bounds the periphery of the antennal fossae (Fig. 36, ant) by a delicate membrane, the antacoria (Fig. 36, antc). The pedicel or second segment (Fig. 36, pd) is distinctly smaller than the scape, about as wide as long, and bears a distinct long setae on its mesal surface near the distal end. It also bears a small number of fine setae. The flagellum, the small mound-like segment on the distal end of the pedicel (Fig. 36, fl), usually appears to be a part of the pedicel, but careful examination shows it to be distinctly separated from the pedicel. The flagellum usually bears three peg-like setae which are probably tactile organs (Fig. 36, ts), and four small oval openings, probably sensoria (Fig. 36, se).

The antennae of *Epilachna* (Fig. 35) are about three times as long as wide; the principal part of the elongation is found in the pedicel. In this segment, the peg-like seta at the distal end is clearly a part of the pedicel and does not appear as a part of the flagellum as in the other genera of the family. In all of the genera of the tribe Coccinellini and in the genus *Microweisea*, the antennae are less than twice as long as wide, <sup>and</sup> the antacoria is protuberant and might easily be mistaken for the first antennal segment. The condition of the remaining parts is similar to that of *Chilocorus*. In *Hyperaspis* (Fig. 38, antc), the antacoria is more protuberant than in the Coccinellini, the flagellum is more mound-like, and one of the three apical setae



is much larger than the other two. *Scymnus* (Fig. 39) presents a type of antennae that shows a wide variation from the type found in the other genera of the family. This antenna is wider than long, only slightly chitinized, and flatly conical. The antacoria (Fig. 39, antc) is narrow, the scape (Fig. 39, sc) is about three times as wide as long, the pedicel (Fig. 39, pd) is more than twice as wide as long, its distal end is much narrower than the proximal, and the flagellum (Fig. 39, fl) is more or less mound-like and about twice as wide as long.

**Mandibles.-** All of the coccinellid larvae examined have well developed mandibles. They may be of a crushing type, that is with many dentes as in *Epilachna*, or they may be of a piercing type, that is with one or two dentes as in all of the members of the subfamily Coccinellinae. Within the family, there are all stages of variation between these two extremes. The type of mandibles found in the more generalized forms, *Periplaneta* or *Corydalis*, is that with many dentes. This tends to show that in these forms the mandible is a crushing organ primarily and not for piercing as it appears to be in the specialized coccinellid larvae.

The mandible of *C. bivulnerus* (Fig. 40, 41) is of moderate size, heavily chitinized, somewhat triangular in outline, thick and heavy at the proximal end, and tapering to a bidentate distal point. The proximo-mesal margin of each mandible is provided with a distinct wedge-shaped mola (Fig. 40, mo), and the proximo-lateral margin has a stout spine-like seta. On the cephalomesal margin of each, there is a preartis (Fig. 40, 41, ps) which articulates in a precoila (Fig. 5, pcl); on the caudo-mesal margin, there is a postartis (Fig. 41, poa) which articulates in a





postcoila. The mandibles of Chilocorous are clearly intermediate in form between the two extreme types. The majority of the species studied have mandibles similar to those of Chilocorous and tend to show an evolution from the multidentate type found in Epilachna, which are entirely phytophagous, to the unidentate type found in Hyperaspis, Microweisea, and Scymnus, which are entirely carnivorous. In all of the genera studied, the mola is present, but it is much reduced, in fact almost indistinguishable in Epilachna, and (Fig. 42, mo) shows the extreme condition of its reduction in Microweisea. The mandibles of all coccinellid larvae are connected to the head capsule cephalad and ventrad of the antennal fossae by a small and distinct membrane. This membrane is the mandacoria (Fig. 5, mco). The extensor muscles are attached on the lateral margin between the preartis and the postartis; while the retractor muscles are attached near the mesal portion of the mandibles.

Maxillae.- The maxillae of the Coccinellidae show a greater degree of departure from the primitive type than any other of the movable parts. They resemble, in general form, the maxillae of *Periplaneta* and the larvae of *Corydalis*, but show a more striking resemblance to the conditions found in the maxillae of carabid larvae. Though the coccinellid maxillae are similar in form to those of *Periplaneta* or the larvae of *Corydalis*, they also show a great difference in structure and are much more specialized than those of carabid larvae. In order to homologize the parts of the maxilla, it is necessary to trace the development of this appendage from the more generalized to the more specialized conditions.





In the tracing out of this development, maxillae of the larvae of Carabidae, Lachnosterna, Elateridae, and Curculionidae were found most useful.

Each maxilla of *C. bivulnerus* is moderately large, slightly chitinized, and made up of the following parts; the fused cardo and stipes, palpifer, palpus, and galea. The lacinia is apparently wanting.

Cardo and Stipes.- In the primitive type of coleopterous larvae, the cardines are composed of two sclerites, the subcardo which bears the articulation with the postcoila, and a second sclerite, the alacardo which lies between the subcardo and stipes. This condition is found in the larvae of *Pteristichus* and *Lachnosterna*; while in the larvae of a curculionid beetle, *Phytonomus*, the subcardo and alacardo are fused. A similar condition is found in the larvae of the Elateridae. In the Coccinellidae, the subcardo and alacardo have not only become fused to form the cardo, but the cardo and stipes are fused and the extent of the cardo is only indicated by small and in many cases indistinct notches along the sides of the fused cardo and stipes. This indication of the suture between the cardo and stipes is found in the maxillae of all of the larvae studied and there is but little variation shown. It will be seen from the above that the stipes and cardo must be discussed as one sclerite. This sclerite (Fig. 18, ss+ca) occupies the area at the proximal end of the maxilla cephalad or ventrad of the gula. Its form in *C. bivulnerus* is that of a rectangle, and is about as wide as long, slightly setaceous, and chitinized. This general form of the stipes and cardo is found in all of the genera studied except *Microweisea*, *Scymnus*, and *Hyperaspis*. In



these genera, the stipes and cardo are narrow and elongated. In *Microwisea* and *Hyperaspis*, the proximal end is curved laterad. This curved portion represents the cardo and the remaining part of the sclerite the stipes.

**Palpifer.-** The palpifer is present as a distinct shoulder-like area ( Fig. 18, pf) near the distal margin of the fused stipes and cardo. Its form and position<sup>are</sup> generally constant in all of the genera studied. This area bears at its distal extremity the three-segmented maxillary palpus. The maxillary palpi (Fig. 18, mxpl) are well developed in all of the genera. In *C. bivulnerus* they are stout and slightly chitinized. The first segment is cylindrical, wider than long, and usually with one or two small setae. The second segment is longer than wide and with one or two large setae. The third segment is conical, about one-half as long as wide with two or three setae and with a group of sensory organs at its distal end. The maxillary palpus in *Epilachna* (Fig. 16, mxpl) is much elongated; the proximal segment is nearly twice as long as wide, the second segment more than twice as long as wide, and the conical third segment nearly three times as long as wide. In all of the other genera, the maxillary palpus resembles that of *C. bivulnerus*, and the distal segment of each bears a group of peg-like organs, tactile setae.

**Galea.-** The galea ( Fig. 18, ga) in *C. bivulnerus* is the broad triangular area distad of the palpifer. Its shape and structure are more or less constant throughout the family, the most notable exception being found in *Hyperaspis* ( Fig. 27, ga). In this genus, the galea is rounded and appears to be more or







less sponge-like and bears a few setae. In *Epilachna* (Fig. 16, ga), the distal margin of the galea is densely setaceous, while in all of the other genera of the family it bears only a few setae. There is a peg-like structure on the galea that bears a striking resemblance to the distagalea; this is nothing more than a tactile seta and cannot be interpreted as a distagalea.

**Coriae.**- The mesal margins of the maxillae and the lateral margins of the labium are connected in all of the genera by a distinct membrane, the labiacoria (Fig. 18, lic), and the lateral margins of the maxillae and the mandibles are connected by a similar membrane, the maxacoria (Fig. 18, mxc). An extension of the maxacoria also connects the stipes and cardo to the postgenae.

**Labium.**- The labium of coccinellid larvae differs considerably from that found in the more primitive forms, as the larvae of *Corydalis* and in the adult of *Periplaneta*, in that many of the parts seem to be lacking. The type of labium found in the more generalized coleopterous larvae shows but little resemblance to the coccinellid labium. However, by a study of primitive forms and of the more generalized Coleoptera, one is able to homologize the parts of this labium.

The labium of *C. bivulnerus* (Fig. 18, li) is the more or less membraneous area cephalad and ventrad of the gula and between the maxillae. It appears to be made up of two parts, the submentum (Fig. 18, su) and the ligula (Fig. 18, lig). The mentum is indistinguishable or fused with the ligula. The submentum (Fig. 18, su) is the large proximal portion. It is membraneous, more or less rectangular, usually with four setae, two large ones



which decussate, and two smaller ones. In *Anatis*, *Megilla*, *Coccinella*, and *Hippodamia* there may be many setae on the submentum, the number varying from four in *Hippodamia convergens* to eighteen in *Anatis*. The submentum is not clearly or distinctly separated from the ligula in *C. bivulnerus* but there is a distinct division between the two in *Epilachna* (Fig. 16), while in *Hyperaspia* (Fig. 27), the division between the ligula and submentum is obsolete. In all of the other genera studied, the condition of this division approximates that found in *Chilocorus*. The ligula is the distal portion of the labium. In *C. bivulnerus*, it is composed of the fused stipulae, glossae, and paraglossae. Near the ventro-lateral margin, there is a distinct shoulder-like swelling, the palpiger (Fig. 18, pg), which bears a two-segmented labial palpus ( Fig. 18, lipl). There is a heavy, semicircular, chitinous band ( Fig. 18, cb) that surrounds each palpiger; this probably serves to increase its rigidity. Each labial palpus consists of two segments. The proximal segment is short, as wide as long; while the distal segment is conical, and bears a group of tactile setae at its distal end. The ligula also bears four to six moderately large setae. The type of ligula found in *C. bivulnerus* is remarkably constant within the family, the only notable variation being found in *Hyperaspis*, where the labial palpi have been reduced to a single dome-like segment which bears a few tactile setae ( Fig. 27, lipl).





## II. THORAX.

That part of the body caudad of the head consists of thirteen segments, the dorsal surfaces of which are convex and the ventral surfaces concave or flattened. They may be provided with scoli, senti, parascoli, strumae, verrucae, or chalazae and setae. The variation in the type of armature will be taken up later. The first three segments constitute the thorax and the remainder the abdomen. In all of the genera of the family, the thoracic segments are distinctly separated from each other by a deep coria, more distinct on the ventral than on the dorsal surfaces.

### Prothorax.

The prothorax of *C. bivulnerus* (Figs. 1,2,3, prth) is about two-thirds as long as the mesothorax and metathorax combined. The same is true of *Epilachna*, *Microweisea*, *Scymnus*, and *Hyperaspis*; while in all of the genera of the Coccinellini the prothorax is about one-half as long as the two other segments together.

**Tergum.**- The tergum is convex and oval in outline when viewed from above ( Figs. 1,2, t). In *C. bivulnerus*, the greater part of the dorsum is covered with a dark brown heavily chitinated shield from which the cone-like senti extend. This shield is formed by the fusion of pinacula and its surface is also covered with fine setae. The dorsal shield when viewed from above appears to be rectangular in outline and is divided by a minute white line extending along the dorso-meson. The senti are arranged in three distinct groups, a cephalic one of six is placed in a transverse row near the cephalic margin, a lateral one, placed





near the middle of each lateral margin, and a caudal group of one placed near the middle of each half upon the caudal margin. In *Epilachna*, the dorsal shield does not cover such a large portion of the dorsum. It is more or less oval in outline and bears only the cephalic row of four scoli. Its surface is also covered with short fine setae. In all of the genera of the Coccinellini, the dorsal shield is large and covers the greater part of the dorsal aspect. It is not so heavily chitinized as in *Chilocorus* and is divided longitudinally into four plates; two of these are adjacent on the dorso-meson and each bears three or more large chalazae and many smaller setae, the two lateral plates are smaller than the mesal ones and bear a fringe of large chalazae on their lateral and cephalic margins. In *Microwisea* and *Scymnus*, the dorsal shield is only indicated and very slightly chitinized, but appears to extend over the larger part of the dorsum and bears several large black setae. These are arranged in three transverse rows, a row on the cephalic and caudal margins and another midway between them. In *Hyperaspis*, the dorsal shield is wanting and the tergum is but slightly chitinized, <sup>it is</sup> traversed by three rows of prominent black setae arranged as in *Scymnus* and *Microwisea*, <sup>and</sup> there are in addition to these larger setae many smaller and inconspicuous ones.

**Pleural Area.-** The pleural area in *C. bivulnerus* is the more or less reduced area ventrad of the dorsal shield (Fig. 2, prpl); it extends ventrad to the sternal area. There is a small group of setae cephalo-dorsad of the procoxacolla, in most of the genera studied; this is the only group of setae found on the lateral aspect of the prothorax.



**Sternum.-** The prosternum of Chilocorous is the rectangular area between the coxal fossae. There has been much controversy among morphologists as to the number of sclerites in this area. It is not my purpose to discuss this question, however there are a few landmarks of this region that must be considered in this work. In all of the species studied, a small pit, the furcinia ( Fig. 3, fur), is found near the meso-caudal boundary of the procoxacoria. There is a distinct ridge extending between these pits which probably serves as a place for the attachment of muscles. The prosternum of Chilocorous, Epilachna, Microweisea, and Hyperaspis bears a few small setae and chalazae usually just cephalad of the procoxacoria; while in all the genera of the Coccinellini it bears two distinct verrucae located adjacent to the meson.

#### Mesothorax and Metathorax.

In general the mesothorax and metathorax of coccinellid larvae are so nearly similar that a single description will suffice for both of them. Each of these segments is wider than long, but in other respects they are similar to the prothorax in form.

**Tergum.-** The mesotergum of *C. bivulnerus* (Fig. 1,mst) is distinctly longer and narrower than the metatergum ( Fig. 1,mtt). In practically all of the genera of the Coccinellini, the mesotergum and metatergum are subequal in length, but the metatergum is as a rule wider than the mesotergum. In *Microweisea*, *Scymnus*, and *Hyperaspis*, the mesotergum is longer and narrower than the metatergum. The mesotergum and metatergum of *C. bivulnerus* do not bear dorsal shields. Each tergum bears a transverse row of







four senti, the pinacula of which are distinct and never fused. The median senti are much smaller than the lateral ones. In *Epilachna* there is a small median dorsal shield from which two scoli project; these scoli originate so close together that they seem to be the two forks of a single scolus. In all of the genera of the Coccinellini, the dorsal shield is present on the mesotergum and metatergum as a raised oval area which covers the larger part of the dorsum. The mesal margin of this shield gives rise to a pair of small parascoli, while on the lateral margin a large parascolus is present. The surface of the shield is densely covered with fine setae and in the genera *Coccinellini*, *Hippodamia*, and *Anatis* also bears chalazae. In *Scymnus* and *Microweisea*, the dorsal shield is weakly chitinized, covers the larger part of the dorsum, and bears a small verruca on each side of the meson. *Hyperaspis*, on the other hand, has no dorsal shield nor is there any chitinization to suggest the presence of a shield. The terga bear many long, black, prominent setae which are arranged in more or less transverse rows; one row on the cephalic and one on the caudal annulets of each segment.

**Mesopleural and Metapleural Areas.**- The pleural areas of the mesothorax and metathorax of all of the species studied are well developed. They are the lateral vertical areas between the terga and sterna (Fig. 2, mspl, mtpl). In *C. bivulnerus*, the mesopleural area is much larger than the metapleural; this is also the case in *Microweisea*, *Scymnus*, and *Hyperaspis*. In *Epilachna*, the metapleural area is larger than the mesopleural; while in all of the genera of the Coccinellini they are subequal. The ventral portions of the mesopleural and metapleural areas are obliquely



crossed by a furrow extending caudo-mesad from the coxacoila. In *C. bivulnerus*, the mesopleural area bears two subequal senti, one near the cephalic and one near the caudal margin; the base of each of these senti is provided with a small pinaculum. The meta-pleural area bears two senti, but the cephalic one is much smaller than the caudal. In *Epilachna*, the cephalic area bears a few small setae, while the caudal one bears the large scolus. In the *Coccinellini* the cephalic area usually bears a few small setae, and the caudal one is provided with a parascolus in *Hippodamia*, *Coccinella*, and *Anatis*; while in *Megilla* and *Adalia* this area bears a struma. In *Microweisea*, *Scymnus*, and *Hyperaspis* the cephalic area is smaller than the caudal area, which bears a small verruca in the two former and a few fine setae in the latter.

**Mesosternum and Metasternum.**- The mesosternum and metasternum are so nearly similar to the prosternum that no description is necessary.

**Spiracle.**- In *C. bivulnerus*, the mesothoracic spiracle is located in the small triangular area lying between the mesotergum and the mesopleural area, the protopleurite (Böving 1917). This condition is also found in all of the members of the *Coccinellini* and *Epilachna*; while in *Microweisea*, *Scymnus*, and *Hyperaspis* the mesothoracic spiracle is not located on the tergum, as Böving points out, but distinctly in the mesocoria. The metathoracic spiracles are rudimentary or entirely wanting.

#### Appendages of the Thorax.

**Legs.**- There is a pair of legs on each thoracic segment. But since the general form and structure of each pair is the same,





their only difference being that of size; a description of a single prothoracic leg will suffice for all. The mesothoracic and metathoracic legs are subequal and slightly longer and wider than the prothoracic legs. Each leg is about as long as the body is wide, except in very young larvae in which they are distinctly longer. In adult larvae, they are comparatively stout and fitted for clasping. The coxal fossae are the circular or oval holes in the sternum in which the legs are inserted. The coxa are attached to the coxal fossae by a distinct membrane, the coxacoria. There is a distinct coxacoila on the lateral margin of each coxal fossae in which the coxa articulates. The procoxa (Figs. 2,3, prc) is subcylindrical, short, tapering toward the distal end and bears a few scattered but prominent setae. The protrochanter (Figs. 2,3, prtc) is short, triangular, the ventral surface the longer, and bears a prominent group of coarse setae. The profemur ( Figs. 2,3, prfr) is short, about twice as long as wide, with its dorsal, caudal and cephalic surfaces sparsely setaceous. This condition of the femur is found in Chilocorous and Hyperaspis; while in Epilachna and all of the genera of the Coccinellini, and the genera Microweisea, and Scymnus, the femur is at least three times as long as wide. The protibia (Figs. 2,3, prt1) is about as long as the profemur, one-third as wide as long, and tapering distinctly toward the distal end. The cephalic, caudal, and dorsal surfaces of the proximal two-thirds are densely setaceous; while the entire surface of the distal one-third is densely covered with club-shaped setae or tenent hairs ( Fig. 43, te). The tenent hairs are very numerous in Chilocorous, Epilachna, and all of <sup>the genera of</sup> the Coccinellini; while in Scymnus and Hyperaspis





there are only a few, five to ten, on each tibia, and in *Microweisea* there are only two which are very broad, flat, elongated, and paddle-like (Figs. 44, 45). The protarsus (Figs. 2, 3, prta) consists of a short triangular segment which bears a few tenent hairs. Its distal margin is provided with a sickle-shaped claw (Fig. 43, prcl). This claw is provided with a short, blunt appendiculated tooth on its proximo-ventral angle, and <sup>it</sup> probably serves as an aid in clasping to surfaces. There is some variation in the general shape of the tarsal claw in the various genera of the family and this characteristic serves as a means of separating them.

### III. ABDOMEN.

The abdomen of all coccinellid larvae is composed of ten segments which are connected by a more or less distinct coriae. This coria is usually more prominent on the ventral than on the dorsal aspect. The abdomen is generally subdepressed, widest on its cephalic half, and tapering on its caudal half. The abdomen of *C. bivulnerus* narrows gradually toward the caudal end. The first three segments are about as wide as the metathorax. This is also true of *Epilachna*, and of all of the genera of the Coccinellini in which the first, second, third, and fourth abdominal segments are subequal in width, the remaining segments becoming narrower toward the caudal end. In *Microweisea* and *Scymnus*, the first, second, and third abdominal segments are the widest; caudad of the third the abdomen becomes narrower. In *Hyperaspis*, the first, second, fifth, and sixth segments are sub-



equal in width; while the third and fourth are the widest segments in the body.

Segment One.- In *C. bivulnerus*, the first abdominal segment is slightly narrower and shorter than the metathorax. Its tergum ( Figs. 1,2,) bears four distinct senti arranged in a transverse row. The dorsal senti are adjacent on the dorso-meson and the dorso-lateral ones are placed on each side near the lateral margin of the tergum. There is a small circular pinaculum at the base of each sentis. The dorsal pinacula are brown or yellow colored and the dorso-lateral ones are white. There is also a few inconspicuous setae on the surface of each pinaculum. The lateral aspect is a vertical area, almost square, and bears the large lateral sentus, at the base of which there is a very large pinaculum nearly covering its entire surface. The paralateral group is wanting. The sternum (Fig. 3, st) is about as long as the tergum. The coria between it and the metasternum is not at all distinct. The integument is thin and membraneous and bears two groups of small ventral setae adjacent to the ventro-meson. The ventro-lateral setae are wanting.

Segments Two to Five.- The external structure of segments two to five inclusive is similar, however, each succeeding segment is narrower than the preceeding one. The coriae between the segments are distinct. Each tergum has four senti arranged in a transverse row. The dorsal senti and their pinacula are adjacent to the dorso-meson; the dorso-lateral senti are located in a position similar to those of the first abdominal segment. All of the pinacula are dark brown colored and bear numerous fine setae. Each lateral aspect is almost square and bears a distinct lateral







sentus. The pinacula at the base of these senti are small. In the second and third segments, ventrad of the lateral senti there is a solitary small seta ; while in segments four and five there is a prominent chalaza surrounded by a group of small setae; this group represents the paralaterals. Each sternum is as long as its respective tergum, and the coriae between the sterna are distinct. The integument is thin and membranous, and bears on each sternum four groups of chalazae arranged in a transverse row; those near the meson are the ventral ones and those on the lateral margin are the ventro-laterals. Each chalaza is surrounded by a small group of setae.

Segments Six, Seven, and Eight.- The sixth, seventh, and eighth segments are as long as, but narrower than the preceding ones. The pinacula at the bases of the dorsal senti have become fused on their mesal margins, and they appear to be dumb-bell-shaped. The dorso-lateral senti are shorter than those of the preceding segments and their pinacula are very much reduced. The lateral aspect of each of these segments is similar to that of the preceding ones, except it is considerable smaller. There is a small lateral sentus with a very small pinaculum on the lateral aspect of the sixth and seventh segments; while it is almost a rudimentary sentus on the eighth segment and is without a pinaculum. In *Epilachna*, the lateral aspect of the seventh segment is provided with a distinct parascolus rather than with a scolus as in the sixth; while the eighth segment has a struma and the ninth only a few chalazae. There is a distinct chalaza surrounded by a group of fine setae ventrad of the lateral sentus of each segment. This chalaza and its setae represents the paralateral group. Each



sternum is as wide and long as its respective tergum. The integument of each segment is soft and bears four distinct chalazae arranged in a transverse row. Each chalaza is surrounded by a group of small setae. The ventral groups are adjacent to the ventro-meson, and the ventro-lateral groups are located near the extreme lateral margins of each segment. The coriae between the segments are distinct.

Segment Nine.- The ninth abdominal segment is small, cylindrical, slightly narrower and shorter than the eighth. The tergum is inclined ventrad at an angle of about thirty degrees. The dorsal senti are absent and in their place there are distinct dorsal strumae. The dorso-lateral senti are also reduced to strumae and located near the lateral margins of the tergum. The lateral aspect is small and the senti are wanting, but there is a prominent chalaza surrounded by a group of setae near the ventral margin. This group represents the lateral group; the paralaterals are wanting. The ninth sternum is short, deeply emarginated on the caudal margin, and bears four chalazae arranged in a transverse row. The ventral ones are located adjacent to each other and the ventro-meson and are surrounded by a group of fine setae; while the ventro-lateral ones are without setae. Throughout the family the ninth segment shows the greatest variation in its size, shape, and structure. In Chilocorous the ninth abdominal segment is rectangular, about twice as wide as long, its anterior margin little if any narrower than the eighth segment, the caudal margin is sharply rounded, never serrated, and its lateral aspect bears chalazae and setae. The lateral aspect of the ninth segment in *Epilachna* is rectangular, about twice as wide as long, much nar-





rower than the eighth segment and with the caudal margin broadly rounded. Each lateral aspect bears a small chalaza. In all of the genera of the Coccinellini, the ninth segment is more or less rectangular, the caudal margin is broadly rounded, usually widest near the middle, distinctly narrower than the eighth segment, and never crenulate or serrate. The lateral aspect is provided with numerous setae. In *Microweisea* the ninth segment is conical, about twice as long as wide, much narrower than the eighth, the distal margins sharply rounded, and the tergum is chitinized and brown. The lateral aspect is provided with a few fine setae. In *Scymnus* the ninth segment is conical, about one-half as wide as long, much narrower than the eighth, and not heavily chitinized. In *Hyperaspis* the ninth segment is semi-circular, about twice as wide as long, narrower than the eighth, the caudal margin broadly rounded and never crenulate or serrate. The lateral aspect bears a few fine setae.

**Segment Ten.-** The tenth abdominal segment is as a rule not visible from the dorsal aspect. It appears to be a small ring of thin membrane surrounding the rosetted anal area. In the Coccinellini this membrane is often pigmented and appears black or brown colored. The rosetted appearance of the anal area is caused by the evagination of the rectum. This serves as a sucking disk and aids the larvae in locomotion.

**Spiracles.-** In all the coccinellid larvae there are eight pairs of abdominal spiracles ( Figs. 1,2, abdsp), a pair, <sup>situated</sup> on each abdominal segment from one to eight inclusive. They are located near the cephalic margin of each tergum between the dorso-lateral and lateral senti in *Chilocorus* and *Anatis*, scoli in *Epilachna*,





parascoli, strumae or verrucae in Hippodamia, Coccinella, Megilla, Adalia, and Scymnus, and chalazae or setae in Hyperaspis.

Pores.- There is a pair of repugnatorial pores on segments one to eight inclusive ( Figs. 1,2, rp). These pores are located on each lateral margin of the tergum in the coria between the segments. They emit an evil smelling fluid which is of a repulsive nature and serves to protect the larva from its enemies.

Abdominal Pits.- On each side of the dorso-meson in segments one to eight inclusive there are two small pits. There is another pair on each side of the tergum near the middle about midway between the dorsal and dorso-lateral senti of segments one to nine inclusive. All of these pits are arranged in a transverse row on the tergum. There is another pit on the lateral aspect of segments one to nine inclusive located immediately ventrad of the ventral senti. These pits are probably the points of attachments for muscles.

#### ARMATURE OF THE BODY-WALL.

The armature of coccinellid larvae consists of spine-like setae on the body-wall, or of conical, finger-like or mound-like projections of the body-wall which bear setae. This consists of scoli, senti, parascoli, strumae, verrucae, chalazae, or setae and varies greatly in form in the different tribes and genera of the family. After a study of the larvae of the Chrysomelidae, the probable progenitors of the Coccinellidae, one becomes convinced that Chelymorpha shows perhaps the greatest resemblance to the generalized coccinellids. In Chelymorpha the lateral margins of the body are each provided with a longitudinal row of long branched



projections of the body-wall. The distal end of each of these branches bears a stout seta. Fracker, in his work on lepidopterous larvae called structures similar to these "scoli". He was unfortunate, however, when he applied the same term to a non-branched projection of the body-wall which bears setae upon its trunk. These two structures are so widely different that they cannot be considered as one and the same thing; and for the latter the name *sentus* is proposed. Fracker has also shown that the arrangement and number of setae on the prothorax represents the generalized condition in lepidopterous larvae. This may be true in coccinellid larvae, but there has been no attempt made in this work to homologize the setae or the projections that bear them. Since the arrangement of the setae in the various genera differs, especially on the abdominal segments; this character has been used to some extent in separating genera, and it is, therefore, necessary to adapt a tentative nomenclature for these structures. This nomenclature is based upon the conditions as they are found in the third abdominal segment and has been applied only to the segments of the abdomen.

There is a seta or a projection bearing a seta or setae on each side of the dorso-meson, these are designated as the dorsal group; one on each lateral margin of the tergum is the dorso-lateral group; another on the dorsal portion of the lateral aspect is the lateral group; one on the ventral margin of the lateral aspect is the paralateral group; a small group on the lateral margin of the sternum is the ventro-lateral group; and one on each side of the ventro-meson is the ventral group.

**Scolus.**- The scolus is a branched projection of the body-wall,







usually more than five times as long as wide (Fig. 28). Each branch of the scolus bears at its distal end a single stout seta. The dorsal and lateral surfaces of the thorax and abdomen of *Epilachna* are provided with distinct scoli.

**Parascolus.-** The parascolus is a modification of the scolus in which the projection is not more than three times as long as wide and usually not more than twice (Fig. 30). This structure bears a few short branches which are about as wide as long, each with a seta at its distal end. This modified scolus is designated as a parascolus. This type of armature is found in *Hippodamia*, *Coccinella*, and on the caudal segments of *Anatis*.

**Sentus.-** A sentus is an elongated, cone-like projection of the body-wall which is not branched like a scolus, but bears a few short stout setae upon its trunk (Fig. 29). Fracker called this a scolus, but it differs decidedly from the true scolus and has been called a sentus. Senti are found in *Chilocorus* and *Anatis*. In the latter genus the senti are much shortened and thickened.

**Pinaculum.-** A pinaculum is the more or less chitinized plate which surrounds the base of a scolus, sentus, or parascolus (Figs. 28, 29, 30). It usually bears numerous, small, dark-colored setae. Several pinacula may become fused to form shield-like plates of the body.

**Chalaza.-** A chalaza is a distinct but slight pimple-like projection of the body-wall, considerably wider than long and bears on its distal end a stout seta (Fig. 33). Chalazae are present in practically all coccinellid larvae. They are for the most part found on the sternum and in some cases on the lateral aspect. In *Microweisea* distinct chalazae are found on the dorsal aspect



of the abdomen, there are also distinct chalazae on the dorsal shield in most of the genera of the family.

**Struma.-** A struma is a parascolus that has become shortened, usually appearing to be nothing more than a distinct mound-like projection of the body-wall (Fig. 31) upon which are a few chalazae. This structure was formerly called a tubercule, but the term is misleading and has been applied by various workers to most any kind of an extension of the body-wall. In order to avoid further confusion the term struma is proposed for this structure. Strumae are found in the armature of the abdomen of *Adalia* and *Megilla*.

**Verruca.-** The struma becomes much reduced in some of the more specialized larvae so that it appears to be mound-like, and bears setae instead of chalazae (Fig. 32). This structure has also been called a tubercule by some workers and by others a verruca. Since the term verruca is not misleading or conflicting it should be restricted to structures such as these. Verrucae are found in the armature of *Scymnus* and very small indistinct ones in *Microweisea*, the latter genus also bears chalazae.

**Setae.-** In the most specialized of the coccinellids verrucae and chalazae have become greatly reduced so that the setae are not elevated above the general surface of the body (Fig. 34). Setae are found on the body of all of the more generalized coccinellids, but it is only in the more specialized groups that the setae constitute the only type of armature. The Hyperaspini is the only tribe that I have studied which has only this condition present.

In the more generalized genera the armature of the body





consists of scoli arranged upon the dorsal and lateral surfaces. Such a condition as this is found in the subfamily Epilachninae. In Chilocorous and Anatis the scoli are replaced by senti on the dorsal and lateral aspects, and on these regions in Hippodamia, Coccinella, and to a small extent in Adalia parascoli are present. The projections of Adalia seem to show a stage of transformation between parascoli and strumae; for parascoli are found on the dorsal surface and strumae on the lateral. Strumae are found on the dorsal and lateral regions of Megilla, but on the lateral aspect of the eighth segment there is a verruca. Verrucae are found almost exclusively on Scymnus, while in Microweisea they are very small and closely approximate the form of chalazae. They are also found on the ventral portion of the ninth segment in practically all genera of the coccinellids, the only exceptions being Hyperaspis and Scymnus. Chalazae are found on the dorsal shield and on the shield-like spots of the mesothorax and metathorax of Hippodamia, Megilla, Anatis, Adalia and Coccinella, and a few on the prothoracic shield of Scymnus. The same type of armature is also present on the ventral parts of the thoracic and abdominal segments throughout the family, and on the lateral portions of the eighth and ninth segments of Adalia, Megilla, and Scymnus. They are usually surrounded by a group of finer setae. In Hyperaspis and its allies the armature of the body has been so reduced that it is composed of setae forming a hair-like covering over the entire surface. The ventral surface of all of the members of the family is provided with setae rather than scoli, parascoli, senti or strumae. Even in those genera where chalazae or verrucae are found on the ventral surface, setae are also found abundantly.



The type of armature of the Coccinellidae shows a steady and unbroken series of changes in specialization from the generalized scolus to a seta through reduction or the disappearance of parts.





SYNOPSIS OF LARVAE.

In the taxonomic study of any group of organisms, the investigator must not be led to draw conclusions from characteristics which upon the surface may show a high degree of specialization or generalization, without first making a careful study of these characteristics, no matter how important or unimportant they may seem. According to Comstock, " The logical way to go to work to determine the affinities of the members of a group of organisms is first to endeavor to ascertain the structure of the primitive members of this group; and then endeavor to ascertain in what ways these primitive forms have been modified by natural selection." With such a view as this in mind, the taxonomist must not only study the members of the group upon which he is working, but he must also endeavor to ascertain the conditions that existed in the progenitors of the group. It is obvious, then, that those conditions in the chosen group which are most nearly similar to the conditions in their progenitors are the most generalized; further, that those individuals possessing these primitive characteristics are the generalized individuals of the group. There are often two or more sets of prominent characters, and many times these may not run in parallel lines, but seem to deny each other or to run in opposite directions. For instance in the larvae of the Coccinellidae, that form which shows the most generalized condition of the head sutures, the *Epilachninae*, have also what seems to be the most highly specialized condition of the setae or scoli on the body; and *Hyperaspini* which have the most highly specialized condition of the head sutures have what appears to be the most gen-



eralized condition of the setae.

If one studies the conditions present in the Chrysomelidae, the probable progenitors of the Coccinellidae, he will find in the genus *Chelymorpha* conditions of the epicranial suture and scoli similar to those found in the *Epilachnini*. The epicranial stem in *Chelymorpha* is long and the epicranial arms are gradually divergent, a condition almost identical with that of the *Epilachninae*. The members of the subfamily *Coccinellinae* have a much shorter epicranial stem, or in many genera it may be entirely wanting and the epicranial arms diverge immediately from the occipital foramen. Even the epicranial arms are wanting in the adult larvae of *Scymnus* and *Hyperaspini*; further the clypeal suture which is distinct and entire in *Chelymorpha* and *Epilachna* is incomplete and only indicated on each margin of the head in the *Coccinellinae*. This fact tends to show a complete reduction of the sutures which are distinct in *Epilachna* and are entirely wanting in *Hyperaspini*, or else only slightly indicated.

The condition of the armature of the body also shows a like reduction. In both *Epilachna* and *Chelymorpha* scoli are present. In *Chilocorus* the scoli are replaced by senti, and in those forms which show a further reduction of the epicranial arms we find that the conditions of the armature of the body is likewise reduced. In *Hippodamia*, *Coccinella*, *Adalia*, *Anatis*, and *Micro-~~weisea~~* forms in which the epicranial arms alone are present, the armature consists of parascoli, strumae, verrucae, and chalazae or setae; while in *Hyperaspini* in which the epicranial suture is wanting, the body is provided only with setae. The condition of the scoli in *Epilachna* might easily be taken as a highly special-





ized characteristic, but when one studies the characteristics of the progenitors of the Coccinellidae, he finds such a condition in the armature of the body as is found in the Epilachninae. There is a further likeness between the Chrysomelidae and the Epilachninae that seems also to be of importance, that is the food habits of the two are almost identical, both are phytophagous. The Epilachninae are perhaps the only group of coccinellids that are entirely phytophagous in both the larval and adult stages.

The fact that the setae in Hyperaspini show an apparently generalized condition, while the epicranial suture is absent in the adult larval stages and present in the first larval stages, surely a specialized condition, does not interfere with this proposed classification. For specialization, as Comstock has pointed out, may take place in two wholly different ways. "First, by the addition or complication of parts, specialization by addition; second, by the reduction in the number or the complexity of the parts, specialization by reduction". The latter is considered to be the case in Hyperaspini; the primitive scoli have been reduced to setae. Granting this to be true, we can readily see that these two wholly different characteristics, the condition of the scoli and the epicranial suture show in a very striking way the presence of specialization in Hyperaspini and of generalization in the Epilachninae. In the first case, there is the absence of the epicranial stem, the clypeal suture is only indicated and the scoli are reduced to setae; while in the latter there is the presence of the epicranial and clypeal sutures and of scoli similar in form to those of Chelymorpha.

Since, as Comstock has shown, there is such a thing as special-



ization by reduction, and since the progenitors of the coccinellids, as nearly as we can ascertain, have an epicranial and clypeal suture and a well developed system of scoli, it seems to me altogether logical, and with the evidence at hand quite true that the Epilachninae represent a generalized type of coccinellid larvae, though at a first glance they may appear to be more highly specialized.

There is a great variation in the general structure of the larvae of the Coccinellidae. This variation ranges from the phytophagous type found in Epilachna to the extreme carnivorous type found in Scymnus and Hyperaspis. The larvae of the family possessing the phytophagous type of structure can very easily be mistaken for certain chrysomelid larvae which they resemble in general shape and in the arrangement of their scoli and pinacula. While the more carnivorous types might at a first glance be mistaken for chrysopid larvae. The coccinellid larvae may be distinguished from this latter group by the development of the mandibles which are not so prominent in the coccinellids. The mandibles of all of the carnivorous coccinellids differ from the chrysomelid mandibles in that <sup>they are</sup> ~~it is~~ not so broad and <sup>have</sup> has a less number of dentes; while in Epilachna <sup>they</sup> ~~it~~ very closely resembles the chrysomelid mandibles. All of the coccinellid larvae examined possess three ocelli on the lateral portions of the head, while the chrysomelid larvae may possess from none to six on each side.

The Epilachninae are undoubtedly the most primitive type of coccinellid larvae, a fact which is shown in their likeness to their chrysomelid progenitors. While in the carnivorous coccin-





ellids, Chilocorous is the most primitive and the specialized condition is found in Hyperaspis which is the farthest removed from the chrysomelid larvae.

#### SUBFAMILIES OF COCCINELLIDAE.

- a.- Epicranial suture present, epicranial arms extending one -half the distance from the occipital foramen to a line drawn through the antacoriae; clypeal suture present; antennae slender, more than three times as long as wide; body with scoli.....Epilachninae.
- aa.- Epicranial suture present or wanting, when present, the epicranial stem never extending one-half the distance from the occipital foramen to a line drawn through the antacoriae; clypeal suture never complete, only indicated on each side; antennae short never more than twice as long as wide; body without scoli..... Coccinellinae.

#### Epilachninae.

The body is elongate, oval to fusiform. The dorsal and lateral areas are armed with scoli, the sternum with strumae or chalazae, and the head with a few long setae. The epicranial stem and epicranial arms are always present; the clypeal suture is entire and distinct. The antennae are more than three times as long as wide, inserted more than their own length dorso-mesad of the precoila. Each mandible is heavily chitimized, its mola not well developed, the distal portion with several dentes of



various lengths, the distal dentes the longest.

This subfamily is represented in North America by a single tribe, the Epilachnini. Casey says, " This tribe is represented in the United States by two or three large pubescent species belonging to the single genus Epilachna. One species occurs in small numbers in southern Illinois. The Epilachna are truly phytophagous. Our common species feeds almost entirely upon the squash plant and its relatives. The beetle is commonly called the squash lady-bug. This subfamily is represented in the material studied by a single species. of the genus Epilachna Chev.

*Epilachna borealis* Fab.- The prothorax is slightly chitinized with a transverse row of four scoli on the dorsum near its cephalic margin and a transverse row of small setae off its caudal margin; the pleural area is small and glabrous; the prosternum is short, with two distinct setae on the ventro-meson; the procoxae are distant. The mesothorax and metathorax are subequal in length and width, the dorsum of each with four scoli, two on each side of the meson arising from the same pinaculum; the mesothoracic spiracles are located in the mesocoria, the metathoracic spiracles are wanting; the caudal portion of the mesothoracic and metathoracic pleural areas are each provided with a large prominent scoli; the mesothoracic and metathoracic sterna are each provided with a group of setae on either side of the ventro-meson; the mesocoxae and metacoxae are distant. The coxa is short and subcylindrical; the trochanter is triangular, about as long as the coxa and bears a few sparse setae; the femur is as wide as the trochanter, about twice as long, and cov-





ered with numerous small stiff setae; the tibia is about as long as the femur and about two-thirds as wide, its dorsal and lateral surfaces are covered with short stiff setae, the ventral surface thickly covered with fine setae, and the distal one-third with tenent hairs; the tarsus consists of a single segment which bears the heavily chitinized hooked claw, each tarsus is provided with a few tenent hairs. The terga of the abdominal segments one to eight inclusive are similar. Each tergum is provided with four scoli, the dorsal scoli are adjacent to each other and the meson and the dorso-lateral scoli are on the lateral margins of the tergum. The ninth tergum bears four strumae which represent the dorsal and dorso-lateral groups; the tenth segment is membraneous. Each lateral aspect of segments one to six is provided with a prominent lateral scolus, the seventh and eighth with a lateral struma on each segment, and the ninth with a lateal verruca. The paralateral group is represented by a prominent chalaza surrounded by a group of small setae ventrad of each lateral scolus. Sternum one with two prominent ventral chalazae, the ventro-laterals are wanting; sterna two to nine with two adjacent ventral chalazae, and two ventro-lateral chalazae located near the lateral portion of each sternum; sternum ten is crescent-shaped and armed with setae. The rectum is evaginated to form a disk-like sucker and is used as an aid in locomotion.

#### Coccinellinae.

The body is elongate to oval, dorsal surface convex, ventral surface concave or flat. The body-wall provided with senti, strumae, verrucae, chalazae, or evenly distributed setae. The head is provided with long distinct setae. The epicranial stem and epicranial



arms may be present or wanting, when present, the epicranial stem never extends more than one-third of the distance from the occipital foramen to a line drawn through the antacoriae. The clypeal suture is never entire, but is usually indicated by a distinct furrow on each side which extends mesad from the precoila. The antennae are never more than three times as long as wide, consist of three segments, and are inserted about midway between the ocelli and the precoillae. The mandibles usually have one, two, or three teeth at the distal end, and the proximo-mesal margin is provided with a triangular or mound-shaped mola.

This subfamily includes all of those tribes the members of which are carnivorous. They may also be phytophagous to the extent that they may eat fungus and probably small amounts of pollen.

#### Tribes of Coccinellinae.

a.- Epicranial arms always present; epicranial stem always <sup>present,</sup> unless obliterated by the separation of the epicranial arms, in all larval stages.

b.- The dorsum of the body armed with senti six to eight times as long as wide; the epicranial stem extending one-third of the distance from the occipital foramen to a line drawn through the antacoriae; epicranial arms gradually divergent.....

#### Chilocorini.

bb.- The dorsum of the body never armed with senti six to eight times as long as wide.

c.- Dorsum of the body armed with short senti, parascoli, or strumae; epicranial stem when





present never extending one-third the distance from the occipital foramen to a line drawn through the antacoriae; epicranial arms gradually or abruptly divergent .....Coccinellini.

cc.- Dorsum of the body provided with small verrucae or setae; epicranial stem always obliterated by the separation of the epicranial arms; epicranial arms diverge from the occipital foramen...Microweiseini

aa.- Epicranial stem and epicranial arms never present in adult larvae

b.- The dorsal and lateral aspects of the body with strumae or verrucae..... Scymnini.

bb.-The dorsal and lateral aspects of the body with fine slender setae.....Hyperaspini.

#### Chilocorini.

The body is subovate, widest at the metathorax. The first three abdominal segments are slightly narrower than the metathorax, segments four to eight are successively narrower, the ninth segment is about as wide as long, its caudal margin is broadly rounded, and the lateral margin is provided with a distinct struma; the tenth segment is small and directed ventrad. The dorsal and lateral aspects of the body are provided with long setae the length of which varies on the different portions of the body. The epicranial stem and epicranial arms are present. The



epicranial stem extends about one-third of the distance from the occipital foramen to a line drawn through the antacoriae, divides and forms the two epicranial arms which diverge gradually for a short distance, then widely and extend laterad to a point dorsad of the antacoriae and ventrad of the ocelli where each becomes obsolete. The mandibles are triangular in outline, heavily chitinized, the apex is bifurcated, and the proximo-mesal margin is provided with a distinct mola.

This tribe is represented in the material studied by the single genus *Chilocorous* Leach.

*Chilocorous bivulnerus* Muls.- The head is chitinized, dark, and provided with numerous setae. The epicranial stem and epicranial arms are distinct; the clypeal suture is indicated on each lateral margin of the head. The mouth is directed cephalo-ventrad. The prothorax is provided with a large dark colored dorsal shield bearing ten senti, six of which are in a transverse row near the cephalic margin. The lateral aspect of the prothorax bears a small group of setae cephalo-dorsad of the procoxacoria. The cephalic portion of the prosternum also bears a small group of setae on each side of the meson; the procoxacoriae are distant. The mesotergum is distinctly longer and narrower than the metatergum, each is provided with four large senti arranged in a transverse row, the dorsal senti are distinctly smaller than the lateral ones; the pinacula are small and bear distinct setae. The mesopleural area is longer than the metapleural, both areas are obliquely crossed by a distinct furrow. The cephalic portions of the mesopleural and metapleural areas are subequal in size,





triangular, and each provided with a large sentus, the mesothoracic spiracle is located in the mesocoria near the cephalic margin of the mesothoracic sentus, the metathoracic spiracle is rudimentary or wanting. The caudal portions of the mesopleural and metapleural areas are unequal in size, that of the metapleural area is much larger than that of the mesopleural. The cephalic metapleural sentus is about one-half as long as the caudal one. The mesosternum and metasternum are similar in size and shape. The mesocoria is distinct while the metacoria is obscure. The cephalic portions of both the mesosternum and metasternum are each provided with a chalaza on each side of the ventro-meson, these chalazae are surrounded by groups of setae. The legs are about as long as the body is wide, and the tibia is very densely setaceous. The first abdominal segment is shorter than the metathorax and its tergum bears four senti arranged in a transverse row, the dorsal pinacula are yellow, and the dorso-lateral ones are white; the lateral aspect is rectangular with a large lateral sentus the pinaculum of which covers the greater part of the lateral surface; the paralaterals are wanting. The sternum is about as long as the tergum, the ventral setae are adjacent on the ventro-meson while the ventro-laterals are wanting. Abdominal segments two to five are similar, narrower than the first, the terga are subequal in length, the dorsal and dorso-lateral senti of each segment are arranged in a transverse row, each sentus is provided with a distinct pinaculum. The lateral aspects are nearly square, the lateral senti are larger than the dorso-lateral ones, their pinacula are small; ventrad of the second and third lateral senti there is a small paralateral seta, and ventrad of the fourth and



fifth lateral senti there is a paralateral group of setae surrounding a distinct paralateral chalaza on each segment. The sterna are as long as their respective terga, slightly chitinized, the coriae are distinct, there are four chalazae arranged in a transverse row, each chalaza is surrounded by six or eight small setae. Segments six, seven, and eight are each narrower than the preceeding ones; the dorsal pinacula are fused, the dorso-lateral senti are shorter than the dorso-lateral senti of segments two to five; the lateral aspects are smaller, but are similar in shape to those of the preceeding segments, the lateral aspects of the sixth and seventh segments are provided with small lateral senti, the lateral sentus of the eighth segment is much reduced and the pinaculum is absent; ventrad of each lateral sentus there is a paralateral chalaza surrounded by a group of setae; the sterna are as wide as the terga, the coriae are distinct, the ventral and ventro-lateral groups of setae surrounding the chalazae are present. The ninth abdominal segment is about as wide and long as the eighth, cylindrical and inclined ventrad; its tergum is shield-shaped and has two distinct dorsal verrucae near the caudo-mesal margin; the dorso-lateral verrucae are wanting. The lateral aspects are small, each with a distinct lateral verruca, ventrad of the verruca there is a distinct paralateral chalaza surrounded by a group of setae; the sternum is short, deeply emarginated on the caudal margin; the ventral and ventro-lateral groups of chalazae are present, the ventral chalazae are surrounded by a few setae while the ventro-laterals are represented by a single chalaza. The tenth segment is small, not visible from the dorsal aspect and the rectum is evaginated to form a disk-like sucker. There is a pair of repugnatorial





pores located in the coriae of segments one to seven about one-half the distance between the dorsal and dorso-lateral senti.

### Coccinellini.

The body is fusiform or elongate, widest at the metathorax, usually highly colored with black, red, yellow, orange, or blue; never with senti except in *Anatis* in which the senti are short, thick, but never five times as long as wide, usually with parascoli or strumae. The abdomen becomes gradually narrower toward the caudal end. The ninth abdominal segment is about twice as long as wide, never wider than long as in *Chilocorini* or *Hyperaspini*, never with lateral parascoli or strumae as in *Chilocorini*, dorsum provided with a light colored, slightly chitinated shield bearing many setae or chalazae. The head is heavily chitinated, the epicranial stem, if present, never extends one-third the distance from the occipital foramen to a line drawn through the antacoriae; the epicranial arms are usually widely divergent. The mouth is directed cephalo-ventrad.

The members of this tribe are more numerous in Illinois than those of any of the other tribes. They are almost wholly carnivorous, their only plant food being either fungi or in some cases pollen grains.

### Genera of Coccinellini.

- a.- Epicranial stem and epicranial arms always present; terga one to eight with strumae usually bearing three distinct chalazae and densely covered with fine setae..

Megilla



aa.- Epicranial arms always present; epicranial stem obliterated by the separation of the epicranial arms.

b.- Terga one to eight with senti not five times as long as wide..... Anatis.

bb.- Terga one to eight without senti.

c.- Terga one to eight with parascoli or strumae which bear more than five chalazae and are sparsely setaceous.

d.- Tarsal claw with a distinct appendiculated tooth at its proximal end..... Coccinella.

dd.- Tarsal claw without a distinct appendiculated tooth at its proximal end.....

Hippodamia.

cc.- Terga one to eight with strumae which never bear more than five prominent chalazae and the surface of the strumae densely setaceous.....

Adalia.

Megilla Muls.

This genus is represented in the material studied by a single species.

Megilla maculata DeGeer.- The body is elongate<sup>and</sup> widest at the mesothorax and metathorax. Its general color is black and mottled with light yellow or cream-colored areas. The head is heavily chitinized, the dorsal portion dark and the ventral portion more or less white. The epicranial stem is present as a short line or suture on the dorsal portion of the head extending





about one-fifth of the distance from the occipital foramen to a line drawn through the antacoriae. The epicranial arms diverge laterad and ventrad and become obsolete slightly mesad of the antacoria. The mouth is directed ventrad. The cephalic margin of the prothoracic shield is provided with two small cream-colored spots, and the caudal margin with a yellow boundary. The mesothorax and metathorax have a shield-shaped, cream-colored area on the dorso-meson; the cephalic portion of the mesothoracic and metathoracic lateral aspects are also cream-colored. There is a light colored area on the dorso-lateral portions of abdominal segments one to eight. On the lateral portion of the first segment and on the tergum and lateral aspects of the fourth and fifth segments the integument is yellow. The ventral aspect of the entire larvae is tan colored. The prothoracic shield is provided with many chalazae and numerous setae, the terga of the mesothorax and metathorax<sup>are</sup> provided with a large struma-like shield which bears six to eight chalazae. The lateral aspect of the prothorax is glabrous. The mesothoracic spiracles are situated in the mesocoria near the cephalic margin of the lateral aspect and each spiracle is surrounded by three or four small, black setae. The cephalic portion of the lateral aspect of the metathorax has three or four setae, but the metathoracic spiracles are wanting. The caudal portions of the mesothorax and metathorax are about twice as large as the cephalic and provided with a struma-like plate which bears six to eight chalazae. The sternum of all of the thoracic segments is provided with a small pair of verrucae adjacent to the meson near the cephalic margin of the segment. Each tergum of segments one to eight is provided with a transverse row of four



strumae; two dorsal and two dorso-laterals. Each struma usually bears three distinct chalazae.. The lateral aspects of segments one to eight are each provided with a large lateral struma with four to eight chalazae, segments two to eight with a small mound-like paralateral struma usually with one large chalaza and many setae on each segment. Each sternum of segments one to eight has a transverse row of four chalazae, each chalaza<sup>s</sup> surrounded by a few setae. The ventro-lateral group is wanting on the first sternum. The tergum of the ninth segment is longer than wide, shield-shaped, cephalic margin slightly emerginated, darkly colored and densely setaceous. The lateral aspect is much reduced and bears a single large lateral chalaza; the paralaterals are wanting. The sternum is shorter than the tergum, the caudal margin deeply emarginate and with the ventral and ventro-lateral chalazae distinct. The tenth segment is not visible from the dorsal aspect, slightly setaceous, and appears to be cylindrical when viewed from the ventral aspect. The legs are long and slender about one and one-half times as long as their thoracic segment is wide.

#### Anatis Muls.

This genus is represented in my material by a single species.

*Anatis 15-punctata* Oliv.- The body is elongate<sup>and</sup> widest at the metathorax. The dorsal portion of the head is dark colored while the ventral part of the face is white or yellow. The epicranial stem is absent and the epicranial arms extend cephalad and ventrad from the occipital foramen for a short distance and diverge widely laterad and ventrad and become obsolete dorso-





mesad of the antacoriae. The mouth is directed cephalo-ventrad. The mesothorax, metathorax, and the first eight abdominal segments bear short stout senti from one to five times as long as wide. The prothorax has a distinct parascoli on the caudo-lateral margin of the dorsal shield, there are four or five chalazae cephalad of this parascoli, the caudo-mesal portion of the dorsal shield is provided with a distinct yellow or white shield-shaped area, the cephalic portion of which bears two chalazae adjacent to the meson. The mesal and lateral tergal senti of the mesothorax and metathorax arise from the dorsal shields of their respective segments. The caudal portions of the lateral aspects of the mesothorax and metathorax are each provided with a small sentus. The mesothoracic spiracles are located in the mesocoria and the metathoracic spiracles are rudimentary or absent. The thoracic sterna are all similar, the sternum of each segment has a pair of small verrucae adjacent to each other and the ventro-meson; the coxacoriae are distant. The first to eighth segments of the abdomen are subequal in length, their terga<sup>are provided</sup> with four senti arranged in a transverse row, the dorsal senti of the sixth, seventh, and eighth segments<sup>are</sup> with their pinacula fused in each segment, the dorso-lateral senti of the seventh and eighth segments are short and inconspicuous. The metathorax and the first abdominal segment are each with a small cream-colored caudad of and about one-half the distance between the dorsal and dorso-lateral senti. The lateral aspects of the first and second segments are white, each with a distinct white lateral sentus and pinaculum, the lateral aspects of segments three to eight are cream-colored with their senti and pinacula brown, the lateral



aspects of the seventh and eighth segments are without lateral senti but are with lateral verrucae, ventrad of each lateral sentus or verruca except in the first, ninth, and tenth segments, there is a distinct chalaza surrounded by a few setae, these represent the paralateral group. The sterna of the first to the eighth segments are similar in shape except for the fact that they become narrower toward the caudal extremity. The first sternum has two ventral chalazae adjacent to the meson, the ventro-laterals are wanting, while in sterna two to eight the ventral and ventro-lateral groups are present on each segment; in the eighth and ninth segments the ventral and ventro-lateral groups on each side have become fused so that there appears to be a single pair on each side of the meson. The tergum of the ninth segment is longer than wide, shield-shaped, and with many setae on its surface; the lateral aspect is much reduced and bears the small and indistinct lateral verruca; the paralaterals are wanting; sternum nine<sup>is</sup> with the ventral and ventro-lateral chalazae present. the tenth tergum is not visible from the dorsal aspect and the greater part of the ventral aspect is hidden by the evaginated rectal disk. The legs are long and slender, about one and one-half times as long as the metathorax is wide.

#### Coccinella Linn.

The body is fusiform, elongate and widest at the metathorax. The head is usually light-brown colored and provided with many setae. The epicranial arms diverge immediately from the occipital foramen and become obsolete near the antacoriae. The mouth is directed ventrad and slightly cephalad. The thoracic segments





are provided with a dorsal shield. The dorsal and dorso-lateral aspects of abdominal segments one to eight are provided with parascoli or verrucae, the ventro-lateral aspect with verrucae, and the ventral aspect with verrucae or chalazae surrounded by a few setae. The dorsum of the ninth abdominal segment is shield-shaped and densely setaceous, the ventral aspect is provided with verrucae or chalazae, and is about one-half as long as the dorsal aspect. The legs are well developed, stout, and extend beyond the lateral margins of the body, The coxacoriae are distant. The basal portion of the tarsal claw is provided with a distinct appendiculated tooth.

#### Species of Coccinella.

- a.- Terga one to eight with distinct parascoli; prothoracic shield with two distinct, longitudinal, dark, heavily chitinized areas on each side of the meson.....

.... 9-notata.

- aa.- Terga one to eight with strumae; prothoracic shield with a single dark, heavily chitinized area on each side of the meson..... sanguinea.

*Coccinella 9-notata* Herbst.- The body is fusiform usually stout, and widest at the metathorax. The dorsal and dorso-lateral surfaces are provided with parascoli, and the ventro-lateral surface with small verrucae. The general color is light grayish-brown to dark tan or brown and marked with white or lemon-yellow areas. The dorsal portion of the head is light-brown and the face is cream-colored. The epicranial arms diverge from the



occipital foramen, and the mouth is directed slightly ventrad and cephalad. The prothorax is wider than long and, as seen from above, is oval in outline. The dorsal shield covers the greater part of its dorsal surface and bears four distinct dark-colored, longitudinal areas, the cephalic, lateral, and part of the caudal margins are provided with chalazae. The mesothorax and metathorax are subequal in size, each is about twice as wide as long and the dorsal surfaces of each are provided with a small oval dorsal shield on each side of the meson. There is a small dorso-lateral parascolus on the caudo-lateral portion of both the mesothorax and metathorax. Each thoracic sterna is provided with a pair of verrucae which are adjacent to the ventro-meson. The dorsal and dorso-lateral portions of abdominal segments one to eight are provided with parascoli. The dorsal parascoli are brown; while the dorso-lateral and lateral ones of the first and fourth segments are white or cream-colored, the area near the pinacula of these parascoli is also white. Segments two to nine are provided with paralateral verrucae, segment one has a small paralateral chalaza. The sterna of segments two to nine are provided with four verrucae arranged in a transverse row on each sternum; while the sternum of the first segment has only two verrucae, the ventro-lateral ones being absent. The ventral and ventro-lateral verrucae on either side of the meson of the ninth segment are almost fused so that there seems to be only two in this segment. The dorsal surface of the ninth segment is about twice as long as the ventral, shield-shaped, the caudal margin rounded and densely setaceous. The legs are well developed, long, and stout. The proximal portion of the tarsal claw is provided





with a distinct appendiculated tooth.

*Coccinella sanguinea* Linn.- The body is elongate and widest at the metathorax. The dorsal and lateral surfaces are provided with strumae, and the ventral surface with verrucae or chalazae. The general color of the body is light to dark brown, mottled or spotted with yellow or cream-colored areas. The head is light brown and the face is yellow. The mouth is directed ventrad and slightly cephalad. The prothorax is about three-fourths as long as wide, and the caudal margin is slightly emarginated. The dorsal shield is light brown colored, entire, with a light yellow line on the meson, and the cephalic and lateral margins are provided with chalazae. The mesothorax and metathorax are subequal in size, about twice as wide as long, each with a small oval shield on either side of the meson. There is a light yellow area on the meson between the shields of each segment. The mesothoracic spiracles are located in the mesocoria cephalo-dorsad of the mesocoxacoilae; the metathoracic spiracles are rudimentary. The caudal portions of the lateral aspects of the mesothorax and metathorax each bear a small verruca. The sterna of all of the thoracic segments are provided with a pair of small verrucae adjacent to each other and the meson in each segment. Abdominal segments one to eight are each provided with dorsal and dorso-lateral strumae, each of which bears more than five chalazae and a few scattered setae. The dorsal strumae of the fourth abdominal segment, the dorso-lateral strumae of the first and fourth segments, and the lateral strumae of the first, fourth, and fifth segments are white or light yellow. There is a small paralateral struma which in many cases appears to be verruca-like ventrad of each lateral struma, except in the first ab-



dominal segment in which it is wanting. The sterna of segments one to nine are each provided with the ventral and ventro-lateral groups of chalazae, except in the first segment in which the ventro-lateral groups are wanting. The dorsum of the ninth segment is shield-shaped, the caudal margin rounded, twice as long as its sternum, dark colored, and with many short setae. The legs are long, slender, well developed, and the tarsal claw is provided with a distinct appendiculated tooth at its proximal end.

#### Hippodamia Muls.

The body is fusiform, elongate and usually widest at the metathorax. The head is brown to dark colored and distinctly setaceous. The epicranial arms diverge immediately from the occipital foramen and become obsolete near the antacoriae. The mouth is directed ventrad and slightly cephalad. The dorsum of each thoracic segment is provided with distinctly chitinized shield-shaped areas which constitute the dorsal shields. The dorsal and dorso-lateral aspects of the body are provided with parascoli. The tergum of the ninth abdominal segment is shield-shaped, setaceous and with the caudal margin broadly rounded. The ventro-lateral aspect of the body is provided with small strumae; while the sterna are all provided with verrucae. The legs are well developed, extend beyond the sides of the body, stout and with the tarsal claw not provided with a distinct appendiculated tooth at its proximal end. The coxacoriae are distant.

#### Species of Hippodamia.

- a.- Dorsal shield with two brown or black, chitinized plates on each side of the meson.....convergens.





aa.- Dorsal shield with a single brown or dark, chitinized plate on each side of the meson..... 13-punctata.

*Hippodamia convergens* Guer.- The body is elongate, widest at the metathorax and the dorsal and lateral surfaces are provided with parascoli. The general color of the body is dark-brown to black, marked with yellow, orange, red or white. The head is dark-brown to black <sup>and</sup> the face is lighter than the dorsal part. The epicranial arms diverge immediately from the occipital foramen and become obsolete dorso-mesad of the antacoriae. The mouth is directed ventrad and slightly cephalad. The prothorax, when viewed from above, is oval in outline and wider than long. The dorsal shield is provided with four longitudinal dark colored areas separated by white or orange colored bands. The cephalic and lateral margins of the dorsal shields are provided with chalazae. The dark plate-like spots also bear chalazae and resemble strumae. The mesothorax and metathorax are subequal in length. The dorsal surface of each is provided with parascoli, the pinacula of which have grown together on each side of the meson to form a basal shield. The cephalic portion of the lateral aspect of the mesothorax bears the mesothoracic spiracle; ~~and~~ the metathoracic spiracle of each side is rudimentary. The caudo-lateral aspect of the mesothorax and metathorax are each provided with a distinct parascoli, the mesothoracic one is brown and the metathoracic one is white or cream-colored. Each thoracic sternum is provided with a pair of verrucae adjacent to the meson. The terga of abdominal segments one to eight are provided with black or brown parascoli, except the fourth in which the parascoli are orange colored. The



dorso-lateral parascoli of segments one <sup>and</sup> to four are also yellow or orange colored. The lateral aspect is provided with a row of lateral parascoli; those on the first and fourth segments are white and the remainder are brown. The lateral aspect is also provided with a row of brown paralateral strumae ventrad of the lateral parascoli. Sterna two to nine are provided with a transvers row of four verrucae on each segment; sternum one bears only two ventral verrucae which are adjacent on the ventro-meson; the ventro-lateral ones are absent. The dorsum of the ninth abdominal segment is shield-shaped, twice as long as its sternum and provided with many setae or chalazae. The legs are well developed and extend beyond the sides of the body. The tarsal claw is without an appendiculated tooth.

Hippodamia 13-punctata.- The body is slender, elongate <sup>and</sup> widest at the metathorax. The dorsal and lateral surfaces are provided with parascoli. The general color is brownish-tan to dark-grayish-brown and the head is darker than the remainder of the body. The head is heavily chitinized, the epicranial arms do not meet but extend separately to the occipital foramen. The mouth is directed cephalo-ventrad. The prothorax is wider than long, and, when viewed from above, is oval in outline. Its entire surface is covered with a solid, brown dorsal shield which has a fine white line running along the dorso-meson. The cephalic, lateral and caudal margins are provided with distinct chalazae. The mesothorax is slightly longer than the metathorax, about twice as wide as long, with a distinctly chitinized, oval, shield-shaped struma on either side of the meson. This struma bears ten to fifteen chalazae. The metathorax is more than twice as wide as long and provid-





ed with a chitinized shield-like struma on each side of the meson. This struma bears about as many chalazae as the mesothoracic strumae. The cephalic portion of the lateral aspect of the mesothorax and metathorax bears the thoracic spiracles. The mesothoracic spiracles are prominent and are located in the mesocoria cephalo-dorsad of the coxacoriae; the metathoracic spiracles are rudimentary. The caudal portion of the lateral aspect of the mesothorax is provided with a brown struma; while the metathorax is provided with a white struma. Each thoracic sternum is provided with two distinct verrucae adjacent to the ventro-meson. The legs are well developed and extend beyond the sides of the body. The tarsal claw is without a distinct appendiculated tooth. The terga of abdominal segments one to eight are provided with distinct dorsal parascoli located near the dorso-meson; those on the fourth abdominal segment are white. The lateral margins of terga one to eight bear the dorso-lateral parascoli, the first and fourth are white and the remainder are brown to dark tan-colored. The ninth abdominal segment is longer than wide, the caudal margin is acutely rounded, its dorsal surface is brown colored, chitinized and bears many chalazae and small setae. The lateral aspects of segments one to eight are provided with distinct lateral strumae, those on segments one and four are white. There is a small paralateral verruca ventrad of each lateral strumae. The lateral aspect of the ninth segment bears chalazae. The sterna of segments two to nine are provided with four chalazae arranged in a transverse row on each segment, the sternum of the first segment has only two chalazae present; the ventro-laterals are wanting.

#### *Adalia* Muls.

This genus is represented in the material studied by a single



species.

*Adalia bipunctata* Linn.- The body is elongate, oval in outline, the third and fourth abdominal segments are the widest. The general color is dark brown to bluish-gray, and mottled with light yellow or cream colored spots. The dorsal part of the head is dark brown to black and heavily chitinized; while the ventral portion of the front and clypeus is white or cream colored. The epicranial stem is absent and the epicranial arms curve broadly laterad and mesad to the pretentorinae, giving the front a more or less circular appearance, then extend laterad from the pretentorinae toward the antacoriae near which they become obsolete. The mouth is directed cephalo-ventrad. The prothorax is longitudinally crossed by a median yellow and two lateral yellow stripes. The dorsal shield is not united to the meson of the mesothorax and metathorax and the two portions are separated by a cream-colored area. The lateral aspect of the prothorax is glabrous. The cephalic portion of the mesothorax and metathorax is glabrous; while the caudal portion is large and bears a small but distinct struma on each segment. The mesothoracic and metathoracic spiracles are located in the coriae between the segments. The thoracic sterna are distinct, each sternum bears a pair of small verrucae near its cephalic margin; the coxal coriae are distant. Abdominal segments one to eight are each provided with a transverse row<sup>of</sup> four strumae on the tergum. The mesal portions of the dorsal strumae of the fourth segment are white, while the lateral portions are brown; the dorso-lateral strumae of the first segment are surrounded by a distinct white area, and the dorso-lateral strumae of the second to the eighth segments are surrounded by a much smaller white area. Each struma is provided with





three to five prominent chalazae. The lateral aspects of segments one to eight are yellow and the strumae are brown except in the fourth segment in which they are light yellow. There is a small but distinct chalaza in each segment ventrad or the lateral strumae of segments one to eight which is surrounded by a few setae representing the paralateral group. The ninth tergum is shield-shaped, longer than wide, the caudal margin concave and provided with numerous setae, while the cephalic margin bears only a few chalazae. The tenth tergum is visible from the dorsal aspect as a small, brown colored, chitinized area caudad of the ninth tergum and is provided with a single chalaza on each side of the meson. Each of these chalazae is surrounded by a group of small setae. The ninth sternum is about one-half as long as its tergum, deeply emarginated on its caudal margin and bears two chalazae on each side of the meson; each chalaza is surrounded by a few setae. The tenth sternum is longer than its tergum and bears a dark colored spot near the lateral margins. The legs are slender, well developed and longer than the body is wide.

#### Microweiseini.

The body is small, elongate, fusiform, depressed, widest at the metathorax, provided with setae and light-brown to yellowish-tan colored. The head is dark-brown to black colored, chitinized, the mouth is directed cephalo-ventrad; and the mandibles are unidentate. The epicranial arms diverge slowly from the occipital foramen and become obsolete near the antacoriae. The spear-shaped front and post-clypeus is divided on the meson by a distinct dark colored chitinized bar which extends from the occipital foramen to



the clypeo-labral suture. The prothorax is oval and slightly wider than long; while the mesothorax and metathorax are distinctly wider than long. The terga of the thoracic segments are longitudinally crossed by a small dark-colored area on each side of the meson, more distinct in the prothorax than in the mesothorax or metathorax. The ninth abdominal segment is conical, narrower than the eighth and about twice as long as wide. The legs are well developed, extend beyond the sides of the body, tibiae are provided with two paddle-shaped tenent hairs at the distal end, the tarsal claw bears a distinct appendiculated tooth and the coxal coriae are distant.

This tribe is represented in my material by a single genus.

#### Microweisea Ckll.

The genus is represented in the material studied by a single species.

*Microweisea misella* LeConte.- The body is fusiform, elongate and light-brown to yellowish-tan in color. The head is elongate, dark colored and chitimized. The epicranial arms are present, but the epicranial stem is absent. There is a dark-brown, heavily chitimized bar extending along the dorso-meson from the occipital foramen to near the clypeo-labral suture. The mouth is directed cephalad. The prothorax is wider than long and somewhat oval in outline. There are two brown, chitimized spots near the middle of the dorsum adjacent to the meson. The dorsum is provided with a very few short setae. The mesothorax and metathorax are about twice as wide as long; and the lateral margin is provided with a fringe of fine setae. The sterna of the thoracic segments are





equal in size to that of their respective terga. The prosternum appears to be glabrous; while there is a pair of small verrucae adjacent to the ventro-meson of the metathorax and mesothorax. These verrucae are provided with setae which are about as long as their segments. The coxacoriae are distant and placed near the lateral margins of the sterna. The legs are small, well developed and extend beyond the sides of the body. Each tibia is provided with two paddle-like tenent hairs placed near the distal end of the segment, the tarsal claw bears a distinct appendiculated tooth. Abdominal segments one to eight are similar, except that they become successively smaller. Each tergum is provided with a few small setae which are never as long as the segments. The dorsum of the eighth segment is dark, chitinized and the caudal margin is not emarginate. The sterna and the lateral aspects of segments one to eight are similar in general size and structure. They are membranous and provided with a few small setae. The coriae between the segments are distinct. The sternum of the eighth segment is deeply emarginate on its caudal margin. The ninth segment is longer than wide<sup>and</sup>, the caudal<sup>is</sup> margin narrower than the cephalic. The tergum is shield-shaped, dark-colored, chitinized, the caudal margin acutely rounded and with many setae about one-half as long as the segment is wide. The shape of the ninth sternum is similar to that of its tergum; it is very slightly chitinized and with only a few setae. The tenth segment is cylindrical, directed caudo-ventred, and the rectum is evaginated to form a sucking disk.

#### Scymnini.

The body is small, elongate, fusiform, widest caudad of the metathorax, provided with verrucae, or chalazae and setae and



light-yellow to light-brown in color. The head is slightly chitinized, light colored, densely setaceous and directed cephalad. The epicranial suture is wanting. The prothorax is oval, slightly chitinized and provided with verrucae. The mesothorax and metathorax are about twice as wide as long and are provided with verrucae on the dorsal surfaces and with chalazae and setae on the lateral and ventral surfaces. The abdominal segments are provided with verrucae on the dorsal and lateral surfaces and with chalazae and setae on the ventral. The ninth abdominal segment is cylindrical, about twice as long as wide and the sternum is shorter than the tergum. The legs are well developed and extend beyond the sides of the body, the tibiae bear more than two tenent hairs and the coxae are distant.

This tribe is represented in the material studied by a single genus.

#### Scymnus Kug.

This genus is represented in my material by a single species which could not be determined.

*Scymnus* (sp)?.- The body is fusiform, elongate, flattened, light-yellow or cream-colored to light-brown. The head is circular in outline, very slightly chitinized and provided with numerous black setae which are about one-half as long as the body is wide. The epicranial suture is entirely wanting and the mouth is directed cephalad. The prothorax is slightly wider than long and the dorsum bears the light-brown, slightly chitinized dorsal shield. The cephalic margin is provided with six large black setae which are about one-third as long as the segment, the caudal margin has





six setae about the same size as the cephalic ones, but not so darkly colored; midway between the cephalic and caudal rows there is another of four long black setae. The mesothorax is distinctly narrower and shorter than the metathorax which is broadly emarginate on its caudal margin. Both the mesothorax and metathorax have an oval-shaped verruca on either side of the dorso-meson. This verruca is provided with setae which are about as long as the verruca is wide. The thoracic sterna are distinct. These of the mesothorax and metathorax are provided with a few setae; while the prothoracic sternum is glabrous. The coxae are distant and the legs are well developed, usually white or light-yellow in color and extend beyond the margins of the body. Each tibia is provided with six to eight tenent hairs near the distal end. The tergum of the first abdominal segment is distinctly longer than the second. Each tergum of abdominal segments one to eight is provided with a transverse row of four distinct verrucae. The dorsal verrucae are adjacent to the dorso-meson and the dorso-lateral are near the lateral margin of the tergum in each segment. The lateral aspect of segments one to seven is lobed and each lobe bears a distinct verruca with setae as long as the segment bearing them. The lateral aspect of the eighth segment bears two or three chalazae about as long as the setae on the verrucae. There are one or two distinct paralateral chalazae immediately ventrad of the lateral verrucae and chalazae on segments two to eight; the first segment bears a small paralateral seta. The sterna of segments one to eight are similar to their terga in size and shape. The integument is membranous and bears on each segment a transverse row of small setae. The coriae are distinct. The ninth abdominal segment is longer than wide, slightly



chitinized, with a dark spot near the middle and on either side of the dorso-meson. The tergum is shield-shaped and provided with many dark colored setae. The lateral aspect of the segment appears to be glabrous. The sterna is shorter than the tergum, the integument is membranous and with a transverse row of four small setae. The tenth abdominal segment is cylindrical, glabrous, directed caudo-ventrad and bears the large disk like sucker.

### Hyperaspini.

The dorsal surface of the body is ovate and the first to the fourth abdominal segments are the widest. The prothorax is wider than long and the caudal margin is wider than the cephalic. The ninth abdominal segment is directed ventrad, wider than long, the tergum very slightly chitinized and provided with a few small setae. The body is usually white or yellow in color; the larvae cover themselves with flocculent masses of wax-like excretions. The body is never with scoli, senti, strumae, or verrucae, but is usually armed with setae or small chalazae. In the early larval stages the epicranial suture is present, while in the adult larval stages the epicranial suture is wanting. The antennae are short, three-segmented, and slightly setaceous. The mandibles are provided with a slightly developed mola and the apex is never bifurcate.

### Genera of Hyperaspini.

a.- Cephalic margin of the prothorax with setae about as long as the prothorax is wide and the lateral tergal abdominal setae are about twice as long as the segments bearing them.....Brachyacantha.

aa.- Cephalic margin of the prothorax with setae which are not





as long as the prothorax is wide and the lateral tergal abdominal setae are shorter than the segments bearing them.....Hyperaspis.

*Brachyacantha* Chev.

This genus is represented by a single species.

*Brachyacantha ursina* Fab.- The dorsal portion of the head is slightly chitinized. The head is light yellow, the mouth is directed ventrad and slightly cephalad. The body is elongate, widest at the second and third abdominal segments, white to light-cream-colored, usually covered with a flocculent wax-like excretion. The prothorax is one-half as long as wide. The dorsal shield is wanting, but the cephalic margin of the prothorax bears eight setae which are longer than the segment is wide; the lateral margin bears two setae which are also longer than the segment. The lateral aspect is not well defined and glabrous; the sternum is small and without setae. The mesothorax and metathorax are each about three times as wide as long, and provided with a seta near the lateral margin longer than the segment, the lateral aspects are not well defined. The mesothoracic spiracle is located in the mesocoria near the cephalic margin of the segment, the metathoracic spiracle is wanting or rudimentary. The legs are short and not well developed, rarely extending beyond the sides of the body. Abdominal segments one to eight are similar. The terga are strongly convex, the dorsal and dorso-lateral setae are longer than the segments bearing them, and the spiracles are located near the cephalo-ventral margin ~~margin~~ of each tergum. The lateral aspect of each segment is provided with two large setae which are not longer than the segments bearing them; the lateral setae are larger than



the paralateral ones. The sterna are flat, each one except the first, bears a transverse row of four large setae, in the first segment the ventro-lateral setae are wanting. The caudal margins of the seventh and eighth sterna are deeply emarginate. The tergum of the ninth segment is semicircular, about as wide as long and with the dorsal surface densely setaceous; the ninth sternum is small and bears four small setae. The tenth segment is small, cylindrical, glabrous and directed ventrad.

#### Hyperaspis Redt.

The members of this genus are generally white to cream-colored and the body is usually covered with a flocculent wax-like mass. When seen from the dorsal aspect, the body is oval to elongate in outline, the dorsum is strongly convex and the sternum is more or less flattened. The prothorax is wider than long and bears setae which are not as long as the prothorax is wide. The ninth abdominal segment is semicircular, wider than long and usually retracted into the eighth segment. The legs are small, short and well developed; the mandibles are unidentate and serve as piercing organs. The members of this genus are carnivorous, for the most part they live upon aphids and soft bodied coccids.

#### Species of Hyperaspis.

- a.- Body elongate-ovoid and densely covered with dark hair-like setae.....binotata.
- aa.- Body oval, not elongate, apparently glabrous, but with a few small inconspicuous setae.....signata.





*Hyperaspis binotata* Say.- The dorsal aspect of the body is brownish-yellow to yellowish-gray, the front, vertex and clypeus are spotted with light or dark brown areas and provided with numerous setae. The prothorax is about twice as wide as long and the cephalic and lateral margins bear setae as long as the segment. The mesothorax and metathorax are subequal in length, but the latter is the wider. The lateral margin of the mesothorax is provided with a group of setae about as long as the segment, while the lateral margin of the metathorax has a distinct chalazae on each side which is surrounded by a group of long setae. The lateral margins of abdominal segments one to eight are each provided with a chalaza surrounded by a distinct group of setae. The dorsal surface of the thoracic segments and those of the abdomen are also densely covered with short black setae. The sterna and lateral aspects of the entire larva are provided with a coat of fine and inconspicuous setae. The tergum of the ninth abdominal segment is about twice as wide as long, not strongly chitinized, and the caudal and lateral margins bearing setae which are longer than the segment. The sternum is about one-half as long as the tergum and deeply emarginate on the caudal margin. The tenth segment is small, cylindrical, slightly chitinized and with a few fine setae on its surfaces. The segment is usually directed caudo-ventrad. The rectum has been evaginated to form a sucking disk. The legs are short, well developed, but do not extend beyond the sides of the abdomen in the adult larvae. The coxacoriae are distant.

*Hyperaspis signata* Oliv.- The general form of the body is oval, <sup>and</sup> the dorsal surface is globose. The body is usually light-yellow to yellowish-green in color. The dorsal aspect of the head



is brown, tan, or yellowish gray. The cephalic portions are spotted with small brown or black areas. The head is provided with many setae which are usually the longest setae found on the entire body. The tergum of the prothorax is rectangular and about twice as wide as long, the dorsal shield is wanting and the lateral and caudal surfaces are provided with setae which are about as long as the segment. The mesothorax and metathorax are subequal in length, but the metathorax is wider than the mesothorax. The lateral margins of both of these segments are provided with a few short setae which are not as long as the segment bearing them. The dorsal aspects of abdominal segments one to eight are similar, strongly convex, with a very distinct coria between the segments, the dorsal portions never densely setaceous, but provided with a few setae which are never as long as the segment bearing them. The lateral margin of the dorsal aspect of the abdomen is provided with a series of lobes between the annulets. These lobes are provided with a few setae which are not as long as the segments. The sterna and the lateral aspects of segments one to eight are provided with a few short setae which are almost invisible. The tergum of the ninth abdominal segment is more or less shield-shaped, more than twice as wide as long and with the caudal margin broadly rounded. The lateral and caudal margins bear setae which are not as long as the segment. The ninth sternum is about one-half as long as the tergum, its cephalic margin is broadly convex while the caudal margin is deeply emarginate. The sternum and the lateral aspects are provided with a few small setae. The tenth abdominal segment is retracted into the ninth so that it is as a rule not visible. The tenth segment is small, circular, and membranous.





The rectum is evaginated to form a sucking disk as in the other genera of the tribe. The legs are small, dark brown and well developed, but do not extend beyond the sides of the body.



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## EXPLANATION OF PLATES.

## Abbreviations used.

a.....	antenna.
abdcor.....	abdominal coria.
abdsp.....	abdominal spiracle.
ant.....	antennaria.
antc.....	antacoria.
cb.....	chitinous band.
cls.....	clypeo-labral suture.
co.....	coxacoila.
cp.....	corpotentorium.
cs.....	clypeal suture.
d.....	dentes.
dse.....	dorsal senti group.
dlse.....	dorso-lateral senti group.
ds.....	dorsal shield.
ea.....	epicranial arms.
es.....	epicranial stem.
fc.....	front & postcypeus.
fl.....	flagellum.
fur.....	furcinia.
g.....	gula.
ga.....	galea.
ge.....	genae.
l.....	labrum.
li.....	labium.
lic.....	labiacoria.
lig.....	ligula.





lse.....	lateral senti group.	76
lipl.....	labial palpus.	
lt.....	laminitentorium.	
md.....	mandible.	
mco.....	mandacoria.	
met.....	metatentoria.	
mett.....	metatentorina.	
mo.....	mola.	
mscor.....	mesocoria.	
mspl.....	mesopleural area.	
msst.....	mesosternum.	
mssp.....	mesothoracic spiracle.	
mst.....	mesotergum.	
mtcor.....	metacoria.	
mtpl.....	metapleural area.	
mtst.....	metasternum.	
mtt.....	metatergum.	
mx.....	maxilla.	
mxo.....	maxacoria.	
mxpl.....	maxillary palpus.	
oc.....	ocelli.	
of.....	occipital foramen.	
pc.....	preclypeus.	
pd.....	pedicel.	
pcl.....	precolia.	
pf.....	palpifer.	
pg.....	palpiger.	
poa.....	postartis.	
plse.....	paralateral senti group.	



pre.....procoxa.  
 prco.....procoxacoria..  
 prcl.....procoxal claw.  
 prfr.....profemur.  
 prpl.....propleural area.  
 prst.....prosternum.  
 prt.....pretentorium.  
 prta.....protarsus.  
 prti.....protibia.  
 prth.....prothorax.  
 prtr.....protrochanter.  
 ps.....preartis.  
 pt.....pretentorina.  
 rp.....repugnatorial pores.  
 sc.....scape.  
 sd.....sucking disk.  
 se.....sensoria.  
 sp.....spiracle.  
 st.....sternum.  
 ss & ca.....fused stipes and cardo.  
 su.....submentum.  
 sup.....supratentoria.  
 supt.....supratentorina.  
 t.....tergum.  
 tc.....tarsal claw.  
 te.....tenent hairs.  
 th.....thorax.  
 ti.....tibia.  
 ts.....tactile setae.





v.....vertex.  
vlse.....ventro-lateral senti group.  
vse.....ventral senti group.  
pma.....points of muscle attachment.  
at.....appendiculated tooth



PLATE I.

EXPLANATION OF PLATE.

- Fig. 1. Chilocorous bivulnerus, dorsal aspect.
- Fig. 2. Chilocorous bivulnerus, lateral aspect.
- Fig. 3. Chilocorous bivulnerus, ventral aspect.







## PLATE II.

EXPLANATION OF PLATE.

Cephalic aspect of the head.

- Fig. 4. *Epilachna borealis*.
- Fig. 5. *Chilocorous bivulnerus*, lateral aspect.
- Fig. 6. *Chilocorous bivulnerus*.
- Fig. 7. *Megilla maculata*.
- Fig. 8. *Hippodamia 13-punctata*.
- Fig. 9. *Hippodamia convergens*.
- Fig. 10. *Coccinella 9-notata*.
- Fig. 11. *Anatis 15-punctata*.
- Fig. 12. *Adalia bipunctata*.
- Fig. 13. *Microweisea misella*.
- Fig. 14. *Scymnus* (sp?).
- Fig. 15. *Hyperaspis binotata*.



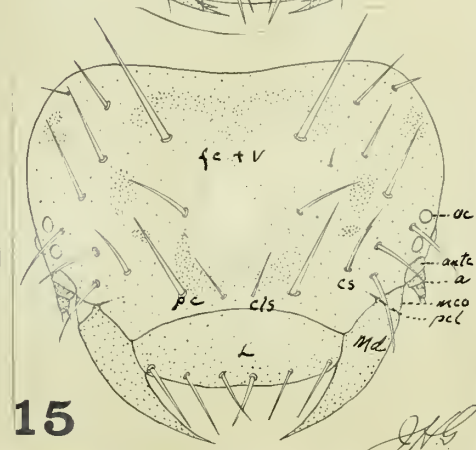
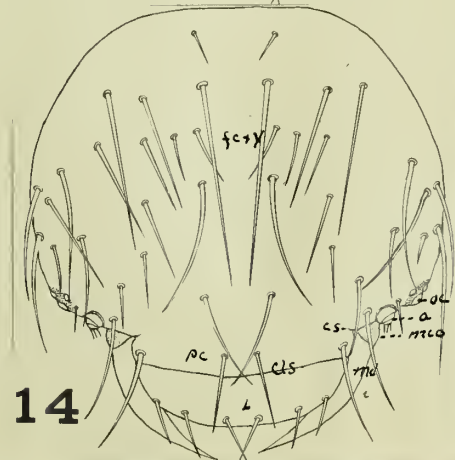
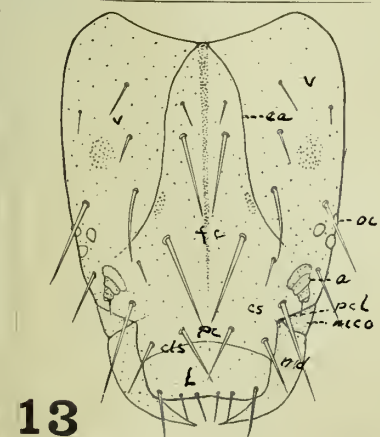
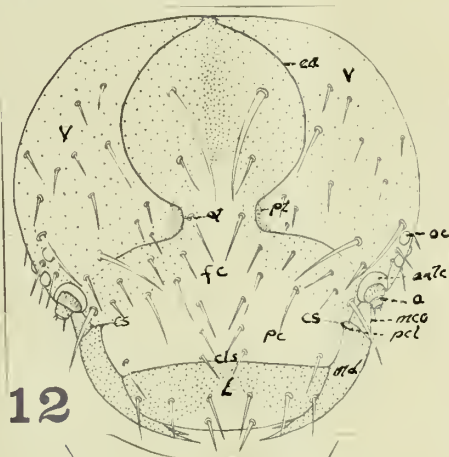
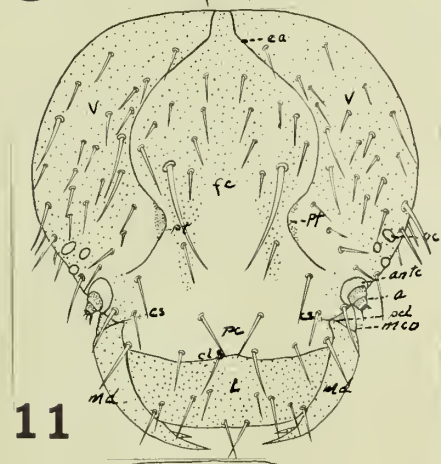
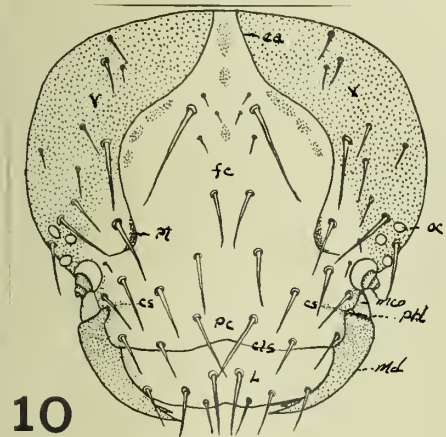
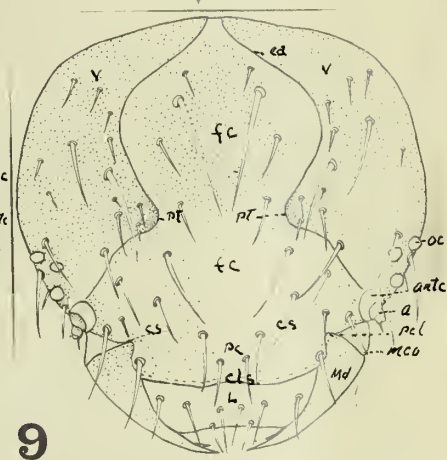
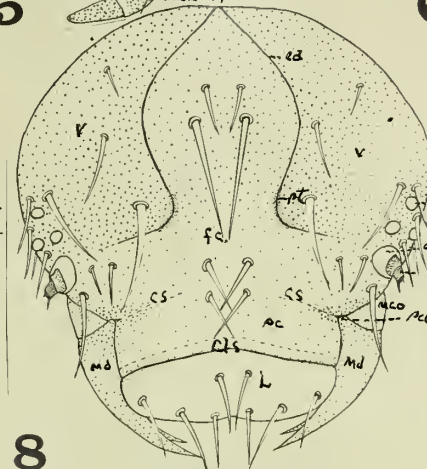
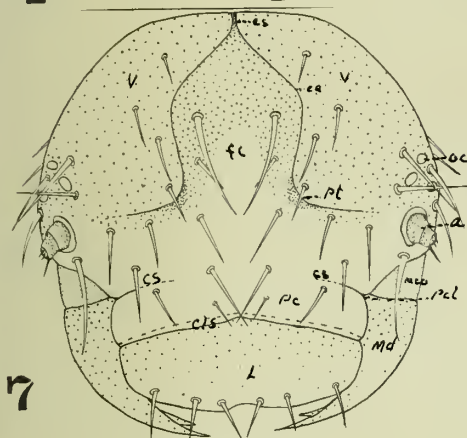
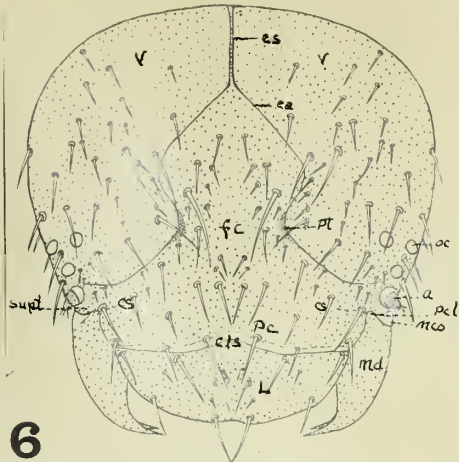
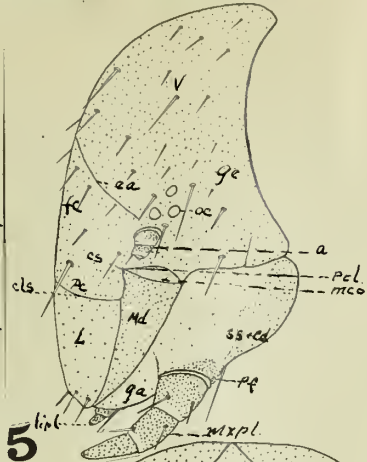
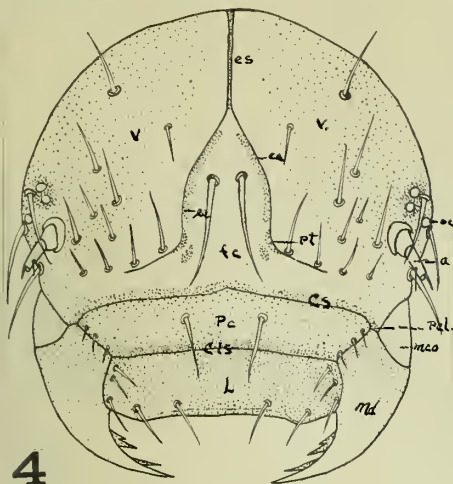




PLATE III.

EXPLANATION OF PLATE.

Ventral aspect of the head.

- Fig. 16. *Epilachna borealis*.
- Fig. 17. *Chilocorus bivulnerus*, caudal aspect.
- Fig. 18. *Chilocorus bivulnerus*.
- Fig. 19. *Megilla maculata*.
- Fig. 20. *Hippodamia 13-punctata*.
- Fig. 21. *Hippodamia convergens*.
- Fig. 22. *Coccinella 9-notata*.
- Fig. 23. *Anatis 15-punctata*.
- Fig. 24. *Adalia bipunctata*.
- Fig. 25. *Microweisea misella*.
- Fig. 26. *Scymnus* (sp?).
- Fig. 27. *Hyperaspis binotata*.



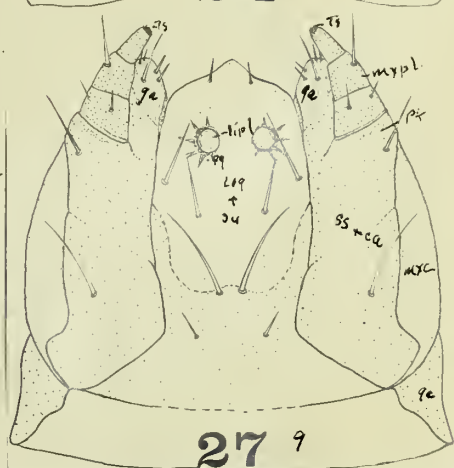
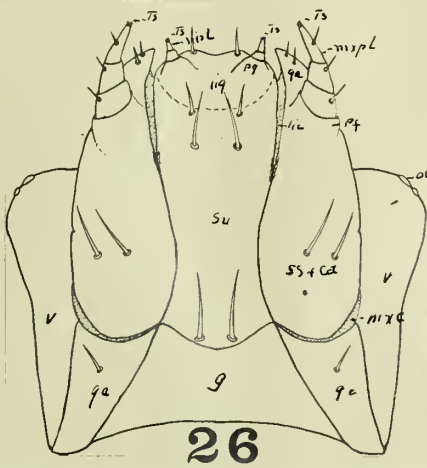
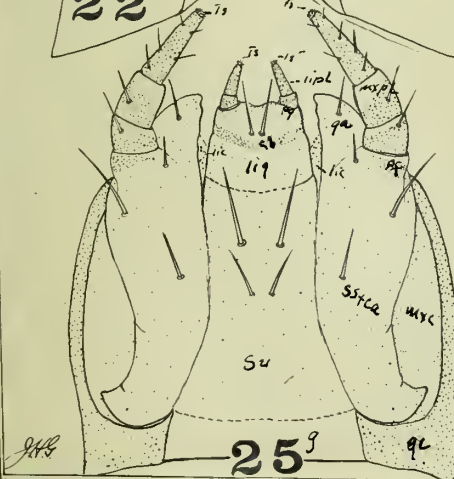
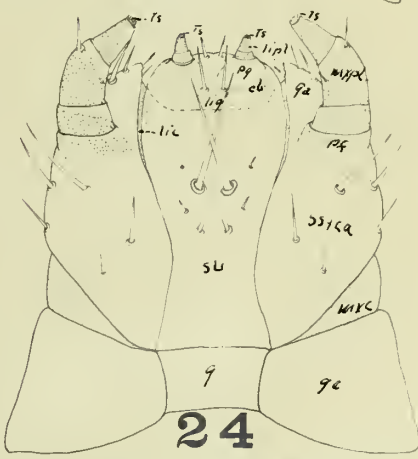
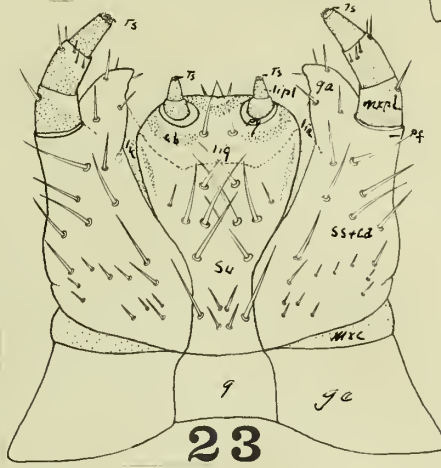
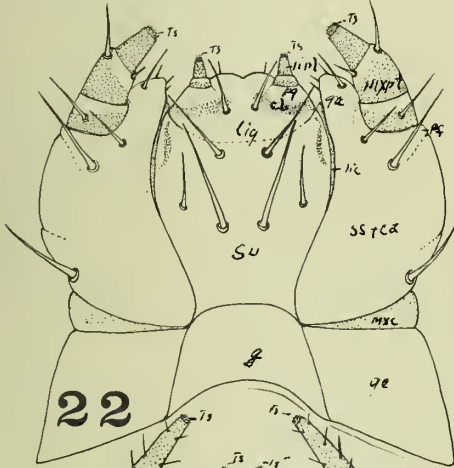
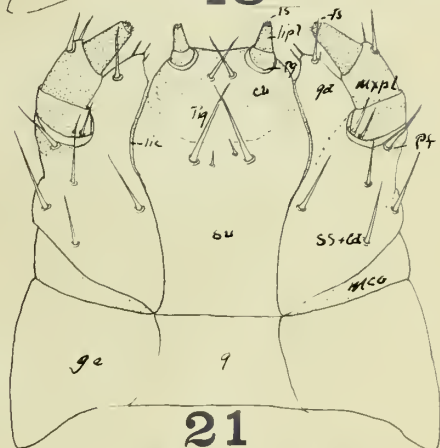
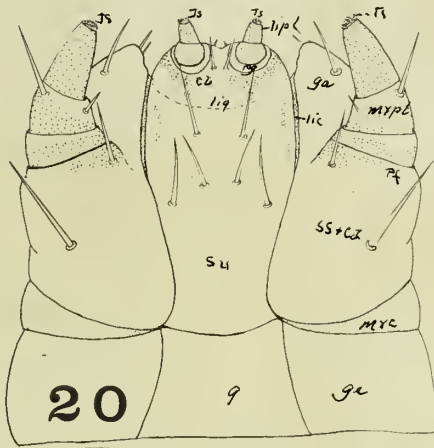
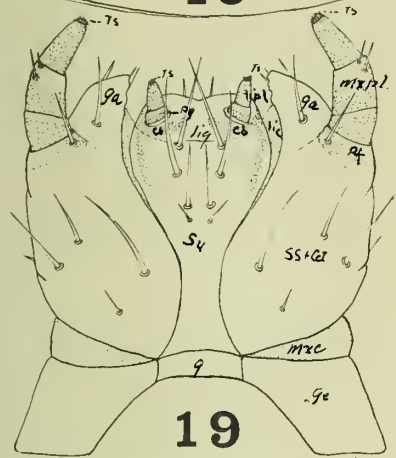
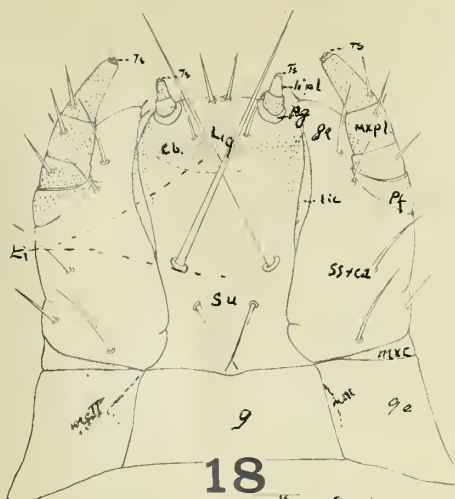
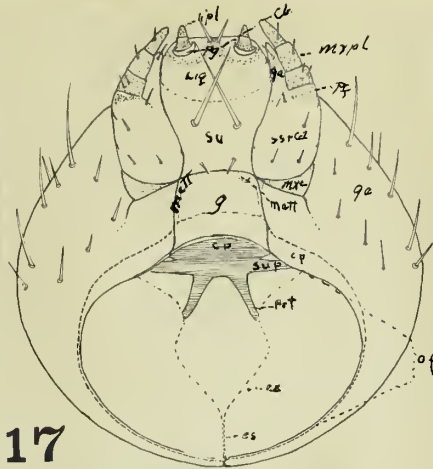
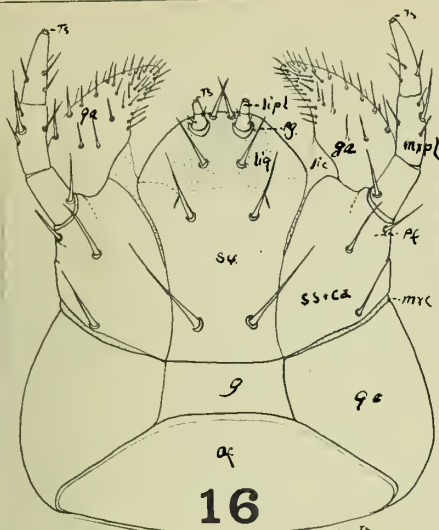




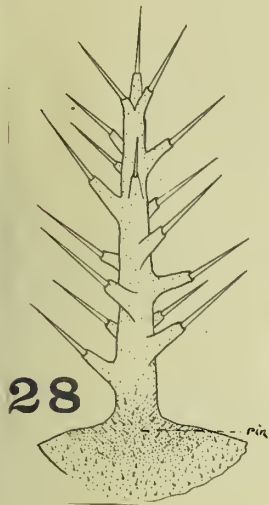
PLATE IV.

EXPLANATION OF PLATE.

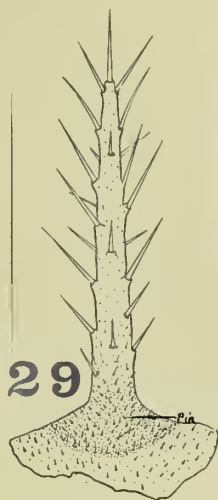
Miscellaneous parts of the body.

- Fig. 28. Scolus.
- Fig. 29. Sentus.
- Fig. 30. Parascolus.
- Fig. 31. Struma.
- Fig. 32. Verruca.
- Fig. 33. Chalaza.
- Fig. 34. Seta.
- Fig. 35. Antenna, *Epilachna borealis*.
- Fig. 36. Antenna, *Chilocorous bivulnerus*.
- Fig. 37. Antenna, *Hippidamia convergens*.
- Fig. 38. Antenna, *Hyperaspis binotata*.
- Fig. 39. Antenna, *Scymnus* (sp?).
- Fig. 40. Mandible, *Chilocorous bivulnerus*, lateral aspect.
- Fig. 41. Mandible, *Chilocorous bivulnerus*, mesal aspect.
- Fig. 42. Mandible, *Microweisea misella*.
- Fig. 43. Tarsus, *Chilocorous bivulnerus*.
- Fig. 44. Tarsus, *Microweisea misella*, lateral aspect.
- Fig. 45. Tarsus, *Microweisea misella*, ventral aspect.
- Fig. 46. Tip of labial palpus, *Chilocorous bivulnerus*.
- Fig. 47. Tentorium, *Chilocorous bivulnerus*.

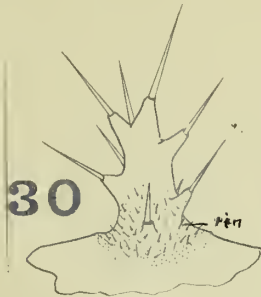




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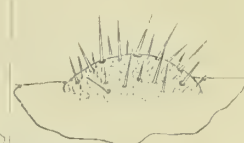
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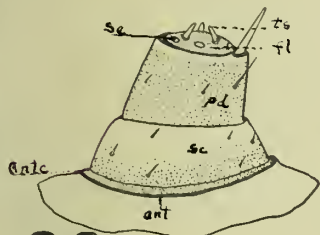
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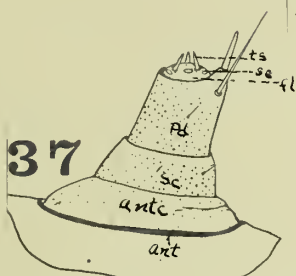
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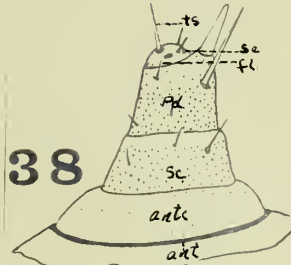
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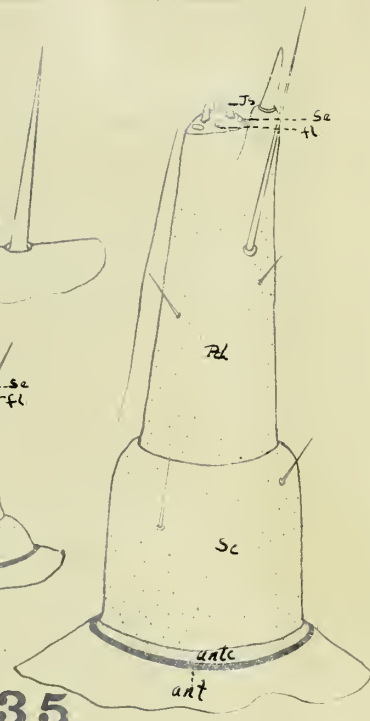
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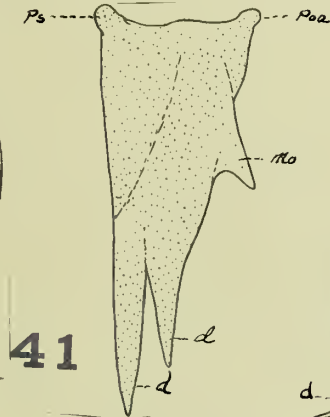
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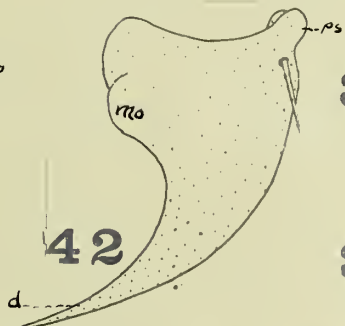
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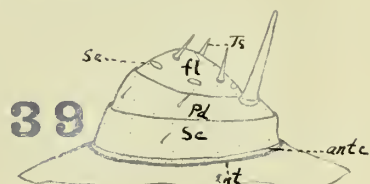
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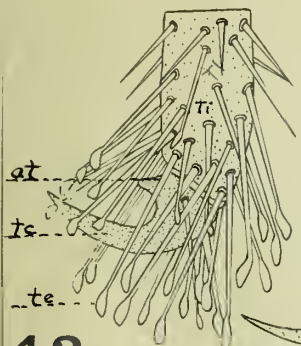
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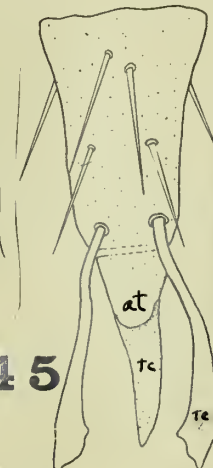
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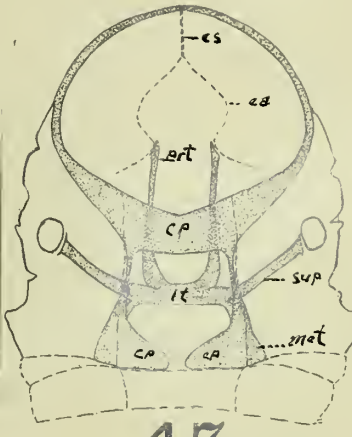
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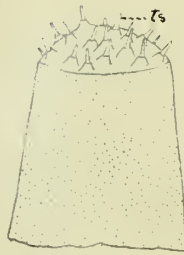
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